ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

VOL. XXI. No. 20.

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"THE SOURCE OF THE MISSISSIPPI" has been discovered again by Mr. G. V. BROWER, sent out for this purpose by the Minnesota Historical Society. This explorer locates the source of the great river in two unnamed large and deep lakes near Whipple lake, but without surface connection with the latter. The theory is that, as these lakes are high and large, there must be an underground discharge into Whipple lake, from which the water passes by marshes into the small Niccolet lakes, and thence by the Niccolet creek to Lake Itasca.

THE SEATTLE, LAKE SHORE & EASTERN RAILWAY, in coöperation with the Canadian Pacific, is rapidly pushing its northern branch to a connection with the C. P. R. at the international boundary line. The length to that point will be 113 miles, and to a connection with the C. P. R. at New Westminster about 130 miles. With this connection completed, Seattle will virtually become the main Pacific terminus of the C. P. R., and the result is likely to be highly beneficial both to that city and to the road, largely increasing its traffic. The project is the more important because the contemplated extension eastward of the Seattle road may, by a slight extension westward of an existing branch of the C. P. R. through the Kootenay Pass, or elsewhere, give that road an alternate route through the Rockies, shorter and of lighter grades than its existing line, and running directly toward Seattle and its rival, Tacoma. This line, when constructed (as it must be in time) would be sure to heavily increase the traffic of the line, and might make the Vancouver "main line" something like the Dunkirk "main line" of the Erie,—in reality a mere branch.

A PROMINENT RAILWAY superintendent is quoted as predicting a reform in fast train service. Instead of long and heavy trains, which must be pulled at speeds well up to the limit of safety on down grades and levels to make up the time lost in climbing grades, the fast trains will be made up with not more than 4 cars and with heavy locomotives able to keep up their speed without slacking on all but the steepest grades. The reduced capacity of such trains would amply justify the extra price for accommodations upon them advocated by Receiver MCNULTA of the Wabash. When the profit and loss account is figured up, however, such trains will seem less attractive than they do in a mere vague proposition.

A FAST CANADIAN STEAMSHIP LINE, probably starting from Halifax, is to be subsidized by the Dominion Government. Halifax is 650 miles nearer Liverpool than New York, or 36 to 40 hours steaming by fast steamers. The rail trip from Toronto is 30 to 35 hours instead of 18 to New York, leaving a net gain of about 24 hours. It is not unreasonably expected that much of the Canadian and western United States travel will be diverted to this line by fast steamers, and it is also expected to carry the Asiatic business this way, in connection with fast steamers from Vancouver.

THE CHAIN-GANG SYSTEM OF BUILDING COUNTY ROADS, as practised in some parts of Georgia, is said to work so well that in Floyd county a gang of 30 convicts macadamized 5 miles of road per year, and have already completed about 40 miles of good turnpike. The advocates of the system maintain that this is a better policy than keeping the misdemeanor convicts idle at the public expense. The gangs work slowly, but the result is secured at one-third of contract prices.

TWO NEW PITTSBURG INCLINED RAILWAYS are to be built on the South Side, and one is now under construction. The Mt. Oliver Incline Railway Co. are to build a freight and passenger incline, parallel to the one they now operate, at a cost of over $200,000. And a rival company is making surveys for another incline about 3,000 ft. long as a competing line. This incline will cost about $350,000 including right-of-way, and will save ten minutes in time for Allentown and Knoxville people coming to the city.

THE WESTINGHOUSE CO. has sold three alternating current dynamos to the State of New York for use in executions. They have a pressure of 1,000 volts, 140 volts sufficing to kill. The remainder of the apparatus for execution is merely an oaken chair, and a metal cap and shoes lined with sponge which is to be wet with salt water before putting them on the criminal. The former active controversy as to which form of current is most deadly is thus definitely settled, but either of them is deadly enough to make them unpleasant to trifle with, and to make whatever difference there is between them in this respect of minor importance.

TIMBER PRESERVATION IN THE SOUTHWEST.—One of the largest timber preservation works in the country is that operated by the Southern Pacific at Houston, Tex. Both the burnetizing (chloride of zinc) and the creosoting processes are in use. The burnetizing process is generally preferred for timber subjected to the Texas climate, as it renders the timber fireproof, and exposure to the sun only tends to harden and preserve it. Creosoted ties have the preserving oil drawn from them by exposure to the sun, but are preferred for damp situations.

There are two treating tubes, each 105 ft. long. The timber and ties to be treated are loaded on tram-cars, and the tube will hold an 11 car train, carrying 330 ties. The capacity of the works is about 1,320 ties each 24 hours. About 40 hands are required, and the work is carried on day and night, Sundays not excepted. In burnetizing, about 5 galls. of the solution are forced into each tie after a steam treatment has extracted the sap and resin. The total cost is 12 to 14 cents per tie. The favorable opinion which the managers of the company have of the process is evidenced by the fact that in January, 1888, the works treated 480,000 ft. B. M. of timber, while in January, 1889, the output was 971,520 ft.

The works are under the superintendence of J. B. DAVIES, who has been in charge since the time they were established.

For the above particulars we are indebted to the Houston *Post*.

THE New York *Sun* evidently has some private axe to grind or private grudge to satisfy in the violent and unreasoning opposition which it is making to the Nicaragua canal. Every few days it comes out with violent attacks like the following, which the experienced newspaper reader can at once see belongs to the class of "news" which does not come from genuine unbiased conviction, but from orders to favor or oppose such and such projects. Under the head of "Nicaragua and Panama" it says:

> One of the most distinguished of American engineers, a man of vast knowledge and experience, who has not failed in anything he has attempted, said the other day that the Panama canal could be taken as it stands, and finished for less money than it would cost to make the necessary preparations, collect the machinery, and get the commencement of work on the Nicaragua canal fairly inaugurated.

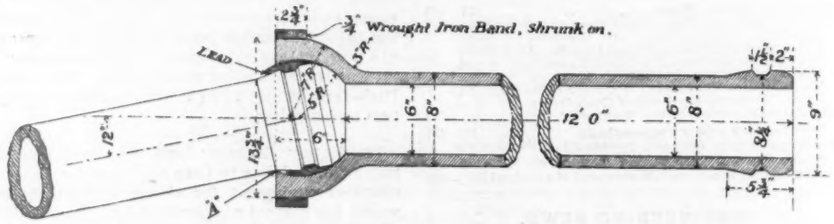
Of course this is a well-considered and just estimate of the two enterprises, and we have no doubt that the engineer we are quoting is perfectly correct in his judgment respecting them.

It then repeats at length its absurd claim that Central America has not been sufficiently explored to determine the best route, that an important individual named GOGORZA has long averred that he has found a much better line than either that of Panama or that of Nicaragua, and that the "neglected duty of exploration should now be done." If there is a spot on the globe where such primary investigations can be said to be needless, it is the Central America in respect to its canal possibilities, since keen-eyed men have been studying it for nearly 400 years, and it would be irrational even to hope to discover more favorable conditions than at Nicaragua; but all this counts for nothing to an unscrupulous newspaper with an axe to grind.

A 6-in. Flexible Joint for Water Pipe.

We are indebted to Mr. JAMES DUANE, C. E., of the New York Department of Public Works, for the accompanying illustration and description of a 6-in. flexible joint designed by him, and during the last year laid to supply North Brothers Island in the East River opposite 140th St.

It will be seen that the joint works on the ball and socket principle, which is too well known to need description. The especial feature of the design consists in the reinforcement of the cast-iron hub by a wrought-iron band securely shrunk on. Experience has shown that where the ordinary cast-iron flexible jointed pipe is subjected to any unusual or excessive strain, rupture very frequently takes place by the bursting of the hub, due to the heavy pressure exerted at some point, as "A," on its interior surface and where the resisting power is least. And this strain generally acts with a very long leverage.



Reinforced Flexible Joint Pipe.

The pipe joints may be so strained in a variety of ways, the most common being due to unavoidable rough handling in laying from a scow in a rapid current, or from the effort of the pipe line to accommodate itself to marked irregularities in the river bed.

In one line, laid with extra heavy pipe, five hubs were split in this manner, and all the pieces were nearly identical in size and shape.

The wrought-iron bands overcame this difficulty very satisfactorily, though the situation was far from being a favorable one naturally. The river was about 1,700 ft. wide, 90 ft. deep, with an irregular bottom, and the New York shore sloped off at an angle of more than 1 to 1. Added to this, there was a rapid tidal current with very short intervals of slack water, and a considerable volume of commerce to be avoided. The line was laid last November in about three days, and has delivered a constant supply ever since under a head equivalent to 45 lbs. pressure.

The leakage is now about 0.3 cu. ft. per minute, less than one-half of one per cent. of the capacity of the main, and is gradually diminishing, due to the silting up of slight crevices in the joints.

THE CORINTH CANAL management, according to the latest reports, has decided to defer payment of interest due to the shareholders. The canal was to be completed within 1888, at a cost of $6,000,000, but this is not possible before 1891, at a cost of double the estimated expenditure. The canal is 3.9 miles long, and its present status and the cause of the increase in quantities and cost was fully described in our issues of Sept. 29, 1888, and June 7, 1884, etc.

A NEW FILTERING MATERIAL.—Carbonized sawdust, saturated with certain chemical compounds, has recently been introduced in Germany as a material for filtering and at the same time decolorizing liquids. Sawdust treated first with alum, and then with sodium carbonate, becomes impregnated with a precipitate of aluminium hydrate, which adheres firmly to it. After being well washed with a solution of barium chloride until no precipitate is given, the sodium sulphate simultaneously produced is entirely removed, and the prepared sawdust is ready for use. Colored liquids filtered with it have their color entirely removed by the formation of flakes with the aluminium hydrate present in the filtering material. A sawdust similarly saturated with barium chloride is used for filtering liquids, from which it is required to remove calcium sulphate, and for the removal of calcium carbonate from a solution, a sawdust that has been treated with magnesium sulphate and caustic soda is employed.

The Loomis System of Incandescent Electric Lighting.

One of the latest systems of electric lighting is that introduced by the Loomis Electric Manufacturing Co., of 18 Broadway, New York, which comes well endorsed by prominent firms who have used it sufficiently long to test the features peculiar to this type of electric light generators.

In the earlier systems of incandescent electric lighting, the dynamo, arranged to supply power for running a certain number of lamps, would continue to furnish the same amount of current when some of these lamps were extinguished. As a consequence, power was wasted, and the sudden increase in intensity of current would destroy the delicate carbon filaments in the lamps; armatures were also frequently burnt out and the lights thus put out, with the resulting inconvenience and expense of renewal.

Fig. 1. The Loomis Dynamo.

The first obvious remedy for this defect was to either reduce the strength of the current, when less light was demanded, by changing the position of the brushes, or by introducing resistance into the circuit. Both of these methods, however, demanded the constant personal attention of the operator and the safety of lamps and armatures depended upon the faithfulness and care of this attendant. This element of cost and danger has doubtless had much to do with the somewhat slow introduction of the electric light as a competitor with the more easily and cheaply managed gas light. But Mr. OSBORNE P. LOOMIS now claims to have perfectly solved this problem by the invention of a system in which the dynamo is entirely automatic and requires no more attention than would a line of shafting; the application of power and proper lubrication on the bearings of the machine is all that is necessary.

The dynamo, as it leaves the factory, is ready to supply a current for its full capacity of lamps as soon as the machine is started and the wires connected. And further than this, the light furnished by each lamp is unvarying in power, kept so by this automatic device, which instantly compels the dynamo to adjust itself to any change in condition. It is claimed that if 100 16 c. p. lamps in one circuit were lighted, and 99 of them suddenly turned off, the remaining one would continue to give out its 16 c. p. light unchanged.

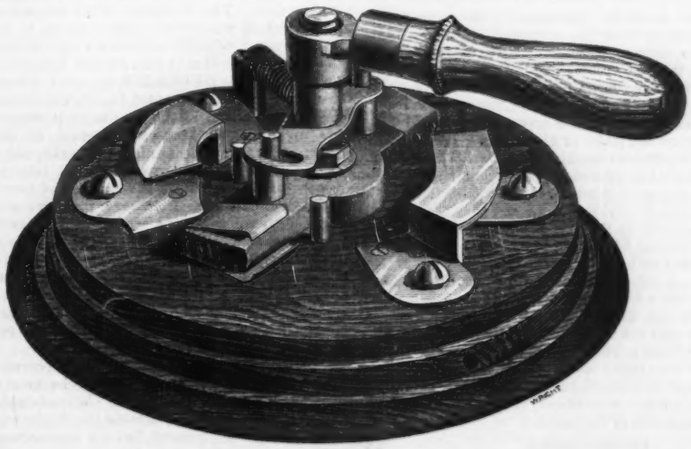


Fig. 3. A Double-Pole Switch.

This self-regulation of the dynamo is not obtained at the expense of wasted power, and careful tests are claimed to prove that there is a most decided economy in it over systems driving the current through resistance coils, or in those in which the brushes have been purposely removed from their positions of maximum efficiency, when less light is required.

To sum up, the advantages claimed for this new system are—economy in plant construction, great economy in maintenance by reason of the automatic action, no stopping to repair burnt-out armatures, and a steady, unvarying light, and consequently longer life to the lamp. The lamp is practically the only destructible part, and the average life is guaranteed to be at least 600 hours. The brushes, being free from the effects of "sparking," will last for years with a nominal expense for renewal. The Loomis system is also installed in strict accordance with the requirements of the Board of Fire Underwriters, and the lamps and the wire protected by safety devices peculiar to this system.

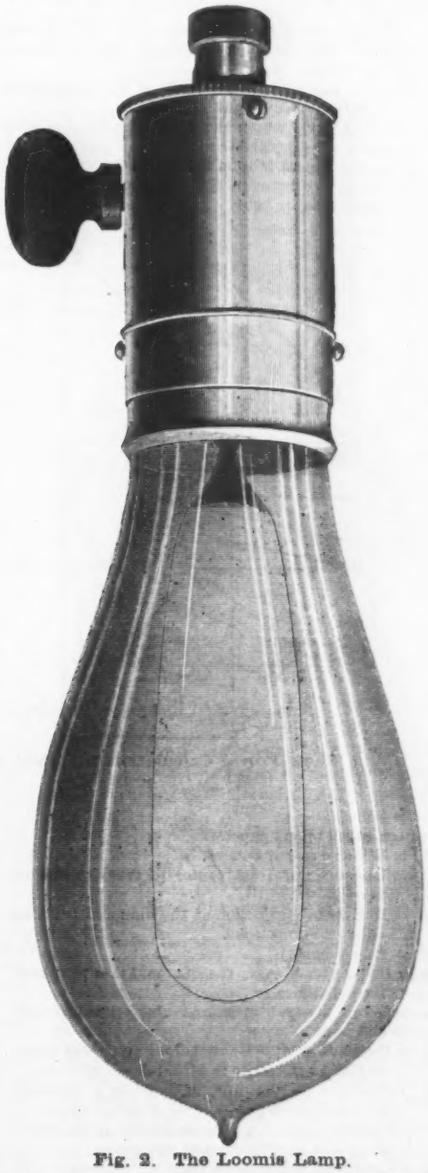


Fig. 2. The Loomis Lamp.

In the illustrations here used, Fig. 1 shows the dynamo ready for the application of the power-belt. Fig. 2 shows a full-size lamp, arranged to prevent all liability of the too common trouble of short-circuiting. Fig. 3 is a double-pole switch, of 75 amperes, selected from the many unique designs of electrical appliances manufactured by this company.

THE THOMSON HOUSTON ELECTRIC RY. IN BOSTON.—The following report for April, of the Cambridge Division of the West End Street Railway, Boston, Mass., is of interest and shows that the electric railway can be depended upon. This road has a previous record of but 9 trips lost out of 1,179.

Average number of motors in daily service	8
Round trips of motor cars	2,720
Time in service, motor cars	3,232 hours.
Mileage of motor cars	17,680 miles.
Round trips, one tow car	2,720
Round trips, two tow cars	226
Time in service, towed cars	3,500 hours 30 mins.
Mileage of towed cars	19,149 miles.
Total round trips	5,666
Total car mileage	36,829

Of the above round trips but 7 were lost.

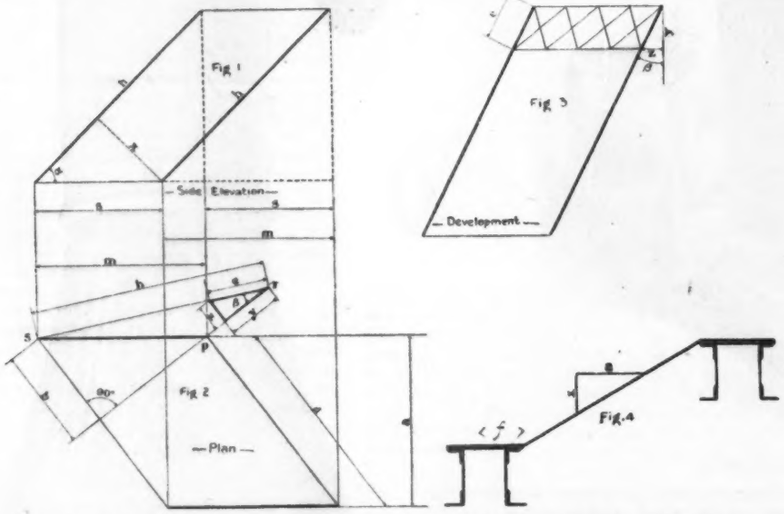
Skew Portals.

The short article on "Skew Portals" given in our issue of April 27, has induced Mr. A. J. LESCHORN, M. E., with the Phœnix Bridge Co., to send in the following method of working similar portal calculations. The method is credited to Mr. MORITZ G. LIPPERT, chief of the draughting department of the Phœnix Bridge Co., and has been successfully used by him since June, 1887:—

The diagrams and data here given will explain themselves to the bridge engineer. The conditions are as follows:—Let

α = The angle which the inclined end post makes with the horizontal.

β = The angle which the line of bend makes with an axis perpendicular to the portal strut. The line of bend is the line in which the connections between the strut and the inclined end post are bent.



Skew Portal Calculations; Method of M. G. LIPPERT, Phœnix Bridge Co.

s = Skew.

m = Length of end panel.

w = Width c to c of trusses.

f = Distance out from center of truss to line of bend.

a = Horizontal projection of the diagonal bend to bend of connections.

d = This diagonal.

b = Projection of m on the diagonal d = the skew for a distance m.

c = Depth of strut measured along the inclined end post.

y = Depth of strut measured along an axis at right angles to the strut = actual depth of strut.

z = Ordinate to the line of bend at a distance whose abscissa is y — bevel of end of strut.

x — Seeming skew, *i. e.*, the projection of the skew as seen in the direction of end posts.

h — Length of inclined end post.

FORMULÆ, REFERENCE TO FIG. 1.

I. $x = s \sin \alpha$.

II. $a = w - 2f$

III. $d = \sqrt{a^2 + s^2}$

IV. $b = \frac{s\,m}{d}$. Since by similar triangles (see Fig. 2) we have $s : d :: b : m$

V. $\sin \beta = \frac{b}{h}$

VI. $\cos \beta = \sqrt{1 - \sin^2 \beta}$

VII. $y = c \cos. \beta$

VIII. $z = c \sin. \beta$

GEOMETRIC CONSTRUCTION AS A CHECK.

Draw the plan, Fig. 2, and the elevation, Fig 1. Through s draw the line $r\,p$ perpendicular to the diagonal d, and about s as a center describe an arc with a radius equal to the length of the inclined end post h. Let this intersect $p\,r$ in the point r. Then the angle $s\,r\,p = \beta$.

The Failure of the Kali Nadi Aqueduct.*

The following is an abstract of a series of reports and other official documents relating to the aqueduct for carrying the Lower Ganges Canal over the Kali Nadi stream. This aqueduct was designed in 1870-3, built soon after (the date of construction is not given), partially destroyed by a flood on Oct. 2, 1884, and completely swept away by another flood on Jan. 17, 1885. It is an instructive example of the danger of too close figuring as to necessary area of waterways.

ORIGINAL DESIGN.

The drainage-area of the Kali Nadi above the aqueduct was estimated at 3,025 sq. miles. Very few data were available for estimating the maximum flood-discharge, but it was assumed that the greatest rainfall in 24 hours would be 6 ins. and if one-fourth of the fall were to flow off in the same time, the discharge would be 38 cu. ft. per second per square mile of drainage-area, or a total of 114,950 cu. ft. per second; whereas the greatest recorded flood (calculated apparently from sections and high-water marks) was 26,382 cu. ft. or 8.7 cu. ft. per second per square mile. That is to say, if the maximum rainfall was 6 ins. in 24 hours, only ¾-in. or 1-18 of the fall, would be discharged in the same time. This difference between the estimated and the actual discharge was considered at the time to be due to two causes: first, that the greatest rainfall in any locality is not continuous over large areas, and secondly, that owing to the flatness of the district, the rainfall from the distant parts of the area must take a considerable time in reaching the point of discharge. It was considered that a sufficient margin would be allowed if the discharge were taken at 12 cu. ft. per second (instead of 8.7), giving a volume of 36,300 cu. ft. To discharge this at a velocity of 10 ft. per second, seven spans of 35 ft. by 15 ft. were provided in the first design, and it was calculated that during high floods the water up-stream would be headed up 2 ft. behind the bridge.

The volume of water in the canal to be carried across the aqueduct was 5,374 cu. ft. per second; the depth was fixed at 9.4 ft. and the width was determined by the consideration that the velocity should not exceed that against which boats could be towed by ordinary means. This velocity was taken to be 4½ ft. per second, or 3 miles per hour, and the width of channel was accordingly fixed at 127 ft. A roadway, 12 ft. wide, was also provided on one side of the canal.

REVISED DESIGN.

When the design was submitted to the superintending engineer, this officer reported that he considered the water-way proposed larger than was necessary. He calculated the highest known flood at 9,500 cu. ft. per second, or 3.66 cu. ft. per second per square mile, a revised survey of the drainage area showing this to be only 2,593 sq. miles. This discharge was admitted to be very small, but was accounted for by the fact that the soil was very sandy, and that the drainage was intercepted at various places by public works. These figures were moreover confirmed by the fact that about ¼ mile down-stream, there was a native bridge more than a century old, having seven openings of 10 ft. 6 ins. span and 14 ft. 6 ins. high from floor to flood-level, and two side openings 8 ft. × 5 ft., giving a total water area of 1,146 sq. ft. It was found by watermarks that the stream was headed up 1¾ ft., the velocity of approach was taken as 1.48 ft., and the discharge calculated taking ($c = 0.6$) at 3,436 cu. ft. per second. A further check was obtained from measurements taken at a point 39 miles above the bridge, during a flood said to be the highest known. Adding to this measured volume a proportion for the additional drainage-area at the site of the aqueduct, the volume here was estimated at 7,033 cu. ft. per second.

In spite of these calculations, however, the superintending engineer considered that a discharge of 3.66 cu. ft. per second per square mile of catchment-basin was too small to be relied on, and determined to provide for 7 cu. ft., a quantity which he stated was often used in dealing with long and large catchment-basins, and, on such a sandy soil, might be adopted without risk. The aqueduct and adjoining river-bed, if properly protected, might easily stand a current equal to that which was supposed to have passed under the old road-bridge, viz., 7½ ft. per second. From these data the water-way was fixed at five openings of 35 ft. x 14 ft. or more than double that of the old bridge ½ mile lower down the stream, and the discharge estimated at about 18,000 cu. ft. per second.

The width of the canal carried by the aqueduct was increased to 192 ft. so as to diminish the velocity to 3 ft. per second, as it was considered that 4½ ft. per second would be dangerous to the earthen embankment at the end of the aqueduct, and would involve a heavy expenditure in pitching the slopes and bed of the canal. The aqueduct was accordingly built to this design, namely, five segmental arches, each 35 ft span; height, from springing of invert to springing of arch, 14 ft. 8 ins.; versed sine of invert, 1 ft. 4 ins. and of arch, 4 ft. 8 ins. The reduced levels of the principal points were as follows:

	Elevation.	Flood-gauge.
Crown of invert[1]	533.50	—1.34
Springing of "	534.84	zero
" arch	549.50	14.66
Crown of arch	554.19	19.35
Canal-bed	558.07	23.23

The abutments and piers were 212 ft. long, and were founded on wells sunk in sand to a depth of 19 ft. below the bed of the Nadi, or 514.5, with curtain wells sunk 10 ft.

A flood-gauge was fixed on the down-stream side of the aqueduct, the zero being fixed at the level of the springing of the invert.

Previous to October, 1884, the highest flood recorded rose to 16.3 ft. on the gauge, or 551.14.

PARTIAL DESTRUCTION OF THE AQUEDUCT.

On October, 2, 1884, the aqueduct was partially destroyed by a flood which rose to 18.7 ft. on the gauge, and was headed up 3.5 ft. higher (or 22.2 ft.) on the up-stream face. The discharge, while the aqueduct was still standing was calculated at 37,600 cu. ft. per second, and the mean velocity (including a velocity of approach of 5 ft. per second) at 11.7 ft., c being taken at 0.74. The discharge, after the breach in the work was made, was roughly estimated at 44,800 cu. ft. per second. The destruction began by the stream, as it rushed through the openings, washing away a part of the kunkur floor, and then undermining the wells, when about ⅓ of the structure gave way and fell into the river. Nearly all the curtain wells were washed away. Out of the 17 foundation wells in each pier, one pier lost 12, another 5, and another 4, while one pier and the two abutments remained intact. In the worse place, however, there remained a width of about 50 ft. of the canal bed, and advantage was taken of this to form a temporary aqueduct, by building a revetment wall for the canal, and in three months and a half after the accident occurred a reduced volume of 1,500 cu. ft. per second was passed down the canal.

A flood of 44,000 cu. ft. per second represented for the drainage-area of 3,025 sq. miles, a discharge of 14.7 cu. ft. per second per sq. mile. The old road-bridge which had been relied on as justifying the water-way for the aqueduct was not injured, but the approaches at both ends were carried away, and the water poured over the road for a length ½ mile and cut through the embankment in several places.

When the extent of the damage had been fully investigated, it was decided that it was useless to attempt to repair it, but that the remains must be removed and a new aqueduct built consisting of 9 spans of 35 ft. No reasons are given for the adoption of this waterway, nor does it appear that any further investigations were made in regard to possible floods in the future.

COMPLETE DESTRUCTION OF THE AQUEDUCT.

On July 17, 1885, a far heavier flood than that of Oct. 12, 1884, came down the stream and completed the destruction of the aqueduct. Between noon and 6.30 P. M.

*Abstracted by WALTER HAMPDEN THELWALL, M. Inst. C. E., from "Selections from the Records of the Government of India, Public Works Department. No. cexl. 1888." for the Proc. Inst. C. E.

[1] This was not a brick invert, but block kunkur pitching 2 ft. thick, grouted.

on July 16, the down-stream water-level rose from 546.4 to 549.0. By 4.30 A. M. on the 17th, it had risen to 553.20 down-stream, and to 559.0 up-stream, but no damage had apparently occurred to the work. Immediately after, however, the water-level up-stream rose 4 ft. in one wave, and the work began to fall in. At about 5 A. M. it became evident that the canal channel was doomed, as cracks began to appear in the new right revetment-wall, and the arch rings of Nos. 3 and 4 arches began to separate from the backing. The left revetment wall and roadway over arches Nos. 3 and 4 and part of the arches themselves subsided at 6.15 A. M. By 8 A. M. the flood at up-stream side had risen to within 6 ins. of the top of the new right revetment wall (567.50), and surged over it in waves 10 or 15 ft. high, and then the whole of this revetment, from abutment to abutment, and arches Nos. 3, 4, and 5 collapsed. Arches Nos. 2 and 1 were blown up shortly after, but leaving about 50 ft. of the old revetment-wall supported by the piers, which obstructed the passage of the flood, and was at 9.30 A. M. the only vestige of the structure visible. The surface velocity of the current, taken by timing floating bodies through the 219 ft. length of the abutments, was 18.25 ft. per second.

The action of the stream below the aqueduct was terrific. The water in the main stream was piled up in waves 20 ft. high at intervals of about 100 ft. apart, and laterally, especially towards the right, spread out into a formidable swirl, which was fast cuttting away the outer slope of the bank.

Ultimately the water cut its way through the canal banks on both sides of the bridge for a length of 50 ft. behind the right abutment, and about 300 ft. behind the left, and the only parts of the aqueduct left standing were about two-thirds of one abutment and two wing walls.

The maximum up-stream flood-level was about 569.00, the down stream level at the time being 556.00, the water being headed up 13 ft. The gap behind the left abutment was 100 ft., that behind the right abutment, 50 ft. Before the arches gave way the up-stream level was 566.00 and 556.00. The length between the up-down stream faces of the aqueduct was 212 ft.

The rainfall in the district on July 16 was 17.6 ins. and 3 ins. more fell on the 17th, the whole 20 ins. having fallen in a little more than 24 hours.

DESIGN FOR NEW AQUEDUCT.

Although engineers were on the spot during the catastrophe and noted the facts as they occurred, they were unable to obtain sufficient data from which to calculate accurately the volume of the flood. For instance, though the lengths of the gaps behind the abutments were measured, it was obviously impossible to obtain sections of them, and hence the sectional area of the flood could only be approximately estimated. The dimensions taken for the calculations were:

Width between abutments $5 \times 35' + 4 \times 7' = 203$ ft.	
Breach behind left abutment	100 "
" right "	50 "
Up-stream flood-level	569.00
Down-stream "	556.00
Bottom of stream	532.00

The breach behind the left abutment must have been obstructed by the fallen masonry of the heavy land wings, and by the kunkur pitching on the left bank of the Nadi, and that behind the right abutment by the up-stream land and river-wings, which were still standing, so that the width of the breach was taken at $\left(260 + \frac{100 + 50}{2}\right) = 275$ ft. The volume was then calculated, taking the width as 275 ft., depth at the down-stream face 24 ft., heading up on up-stream face 13 ft., velocity of approach 3 ft. per second. Taking c at 0.5, the volume was found to be 132,475 cu. ft. per second. To provide for a similar flood in future, a design was prepared for a new aqueduct, having 11 spans of 60 ft. The soil in the bed of the Nadi under the aqueduct, and for 50 ft. above and below it, was to be dredged out to 15 ft. below the bed, and a sunken floor laid of heavy concrete blocks 5 ft. in thickness. The water-way available down to this level, with a velocity of 8 ft. per second, would have been sufficient for a flood of 138,456 cu. ft. per second, equivalent to 58 cu. ft. per second per sq. mile of drainage area, estimated at 2,377 sq. miles.

The length of the aqueduct being increased from 200 to over 700 ft., it became a matter of great importance to reduce the width, and it was necessary to consider what depth and velocity could be given to the water in the canal consistently with the safety of the earthen channel along the embankment. This channel was 192 ft. wide at the bottom, with slopes 1½ to 1, and the gradient was 0.5 ft. per mile or 0.095 per 1,000. The supply required was 4,100 cu. ft. per second. After making a series of calculations as to the relative volumes which could be passed down the earthen and masonry channels, it was decided to allow a depth of 8 ft., a width in the latter of 130 ft. and a gradient of 0.15 per 1,000, giving a supply of 4,111 cu. ft. per second at a velocity of 3.95 ft. In the event of the depth being increased to 9 ft., which was the greatest that the earthen channel could carry, the mean velocity in the aqueduct would be 4.21 ft. and the discharge 4,926 cu. ft. per second. A reference to the Solani Aqueduct on the Upper Ganges Canal showed that the mean velocity with the full supply was 4.24 ft. per second, and proved that the proposed velocity of 4.21 ft. was not excessive. To protect the earthen channel, it was decided to pitch the slopes for a distance of 310 ft. above and below the aqueduct, and the bed for a distance of 310 ft. below and 100 ft. above.

When the design was completed, it was submitted to Colonel BROWNLOW, R. E., Inspector-General of Irrigation, who, on examining the reports of the flood and the calculations founded on them, considered that the discharge had been greatly underestimated. With the data previously given, he was of opinion that the coefficient c should have been taken as = 0.75 at least, instead of 0.5, which would add 50 per cent. to the estimated volume. However, he considered that it would be sufficient to give 15 spans of 60 ft. These spans he proposed to divide into three sets of five each by two abutment piers, and this design was adopted. In addition to the width of 130 ft. for the water channel, a road 11 ft. wide was provided on one side of the canal and a bridle-path 6 ft. wide on the other, the whole width from face to face of the arches being 148.7 ft.

In determining the number of foundation-wells and the depths to which they should be sunk, it was decided that the pressure on the foundations should not exceed 2½ tons per sq. ft. and that 140 lbs. per sq. ft. might be taken as the frictional resistance of the wells in undisturbed soil. Where the ground had been previously dredged out, no reliance was to be placed on frictional resistance. Each abutment and pier abutment was to be founded on a double row of wells of 12 ft. diameter, and each pier on a single row of 20-ft. wells. Ultimately the calculations as to stability appear to have been used only to ascertain the minimum depth allowable, and it was determined to sink all the wells to a depth of 50 ft. The total number of wells will be 268 and the aggregate depth of sinking 15,000 ft. The backs of the abutments and river wings will have a row of sheet piles 15 ft. long and 4¼ ins. thick driven behind them to prevent any settlement of earth.

The available height from the bed of the Nadi (534 to the bed of the canal (558.27) is 24.27 ft. and has been disposed of as follows:—Concrete over arch 0.35 ft., arch ring 4.15 ft., versed sine of 60° arc 8 ft., Nadi bed to springing 11.77 ft.

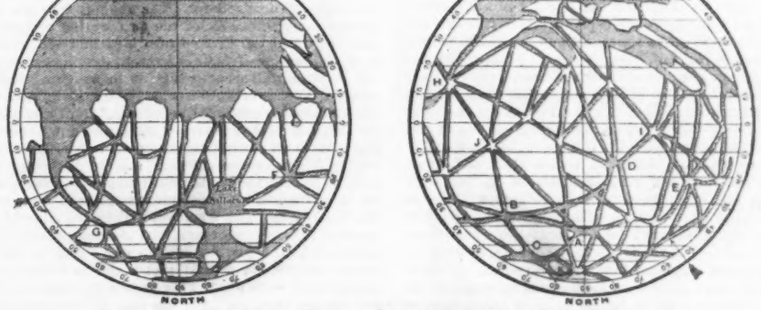
The sunken floor will be laid with its upper surface 10 ft. below Nadi bed, to a distance of 25 ft. above and below the faces of the aqueduct, and will end with aprons 25 ft. long, sloping downwards at an angle of 1 in 5 for 5 ft. so as to protect the main portion of the floor. The excavation for this floor is to be done partly by pumping and ordinary excavation, and partly by dredging from barges by hand and by steam-power. The thickness of the arches varies 4.15 ft. at the springings. Spandrel arches of 4 ft. span, 0.83 ft. thick, with piers 1.7 ft. thick, will be built. Over them will be a course of flat bricks in Portland cement. The floor and sides of the channel will be rendered with Portland cement to make them watertight. In building the arches each set of five will be turned separately. There will be five sets of centerings, each about 32 ft. long, or equal to one-fifth of the length of the arch. Each arch will be built in five sections, the different sections being joined together by masonry wedges built afterwards.

The whole site of the works will be enclosed by embankments raised well above maximum flood-level, so that there can be no interruption to the work except during the periods of actual rainfall.

The estimate for the aqueduct itself is $1,220,800, but other subsidiary works, including canal and Nadi diversions, railway and sidings for bringing materials, buildings, tools, plant, establishment, and miscellaneous expenses, bring up the total estimated cost to $1,599,524.

Map of the Planet Mars.

We extract the accompanying map, showing what are supposed or alleged to be the artificial canals on the surface of the planet Mars, as seen through the great Lick telescope in California, from the just issued volume for 1888 of Appleton's *Annual Cyclopædia*. While we are by no means prepared to accept the bold views advanced as truth, and view the construction of such alleged canals as clearly a superhuman work, yet the speculation is at least an interesting one, and in some respects plausible, and it is not really possible to assert that our Martial neighbors *may* not have means for executing such works which put our feeble machines to shame, and to which we shall only attain after centuries of progress. It is to be remembered that Mars is only 4,363 miles in diameter, and but 0.108 of the earth's mass; the force of gravity at the surface is therefore only 0.387 of the earth's. This decreases by two-thirds the magnitude of the work,



Canals on the Planet Mars, as Seen through the Lick Telescope.

measured by our standards; but it leaves the alleged canals still far beyond all bounds of possible attainment by mortals if not by the Martial demigods.

Prof. HOLDEN is Director of the Observatory, and on the original map each of the "canals" and seas is given a name.

The map of the planet Mars accompanying this article, is a reproduction of that presented by Prof. EDWARD S. HOLDEN in the New York *Herald* of Nov. 28, 1888, entitled "Mars as seen through the Lick Telescope." The canals it represents are, either natural or artificial; due upon the one hand to the forces that accompanied the geological formations of the surface, or, upon the other, to a system of engineering projected by beings like ourselves and designed for the purpose of establishing a means of communication between the inhabitants of the entire planet. If they are due to the latter cause, then a discovery has been made of the highest importance to the development of cosmical science; and for this reason it would seem wise on our part to pass it carefully in review before the best effort of logic we can summon to our assistance. The writer, therefore, submits for consideration the conclusions he has drawn from a careful study of the map, and begs to explain that his earliest experience in the science of engineering was the construction of water-ways in the primitive forest for the purpose of making every available stream navigable for floating down timber and for passing small vessels up and down stream. To one having such experience, the markings on the map of Mars present peculiar analogies.

One of the prominent features of our system of engineering was to avail ourselves of every natural water-way that would save labor and expense, such as lakes, long, deep stretches of stream, rivers, etc. If the reader will look on the map at a place on the thirtieth parallel of north latitude, named Lake Niliacus, he will observe that 6 of these canals enter this sheet of water from different directions. The lake is nearly as broad as it is long, and covers more than 18° of latitude and longitude, which, at the thirtieth parallel of latitude upon Mars means that the lake is about 612 miles across. Therefore if this is a system of Martial engineering, here is a case where the engineers gained 612 miles of natural water-way for each canal. This is just what terrestrial engineers would have done under the same circumstances. Look again at a place marked A, between the fortieth and fiftieth parallels of north latitude. It is about 3° of latitude in width and 16° of longitude in length, which makes it about 90 miles broad and 500 miles long. Fou

canals, from different directions, enter the western end of this long, narrow sheet of water; and three, from different directions also, enter its eastern end; none enter upon its sides. Lake Nilliacus is practically a round lake, and its canals enter on all of its sides; but this is a long, narrow lake, and its canals enter its ends. Here, then, is another example of what a skilful engineer upon our own world would have done under similar circumstances; simply because, by entering a long stretch of water-way at its ends, he gains both the water-way of its length and breadth. If he entered at its sides he would only gain the water-way of its width, 90 miles. The true engineer enters at the ends, because he gains 500 miles of water-way and the 60 besides.

Moving eastward from A to the position B, we come to what is either a section of a widening of the canal system or a natural water-way about 300 miles in length; but, whichever it may be, the same order is observed; it is entered at one end by two canals coming from different directions, and at the other by four, all of which have the same divergent character. Moving northward along one of those canals that lead from its eastward end, we come to a sound of the northern sea formed by the coast of the mainland and that of a large island. This sound, or long, narrow sea, has a length of somewhat over 600 miles and an average width of about 100. At its western extremity it is entered by two canals, at its eastern end by two (here we encounter a little uncertainty, growing out of the fact that the original draughtsman was not sufficiently skilled in map-drawing to make the verges of the two hemispheres coincide) on its southern shore, by the canal that we followed from B to C. This canal trends nearly due north, and a continuation of its course would carry a vessel through the western strait between the island and the mainland into the extension of the Polar sea, still keeping up the character of engineering design hitherto referred to; and it is curiously corroborative of design when we find by the maps given that this system of canals has been pushed as far north as the eightieth parallel; for, as the axis of Mars is inclined to the plane of its orbit 7° more than that of our earth to its orbit, it follows that the sun moves 7° farther poleward in the summer than on our planet, from which fact there is due to the eightieth parallel of latitude on Mars a mean temperature equivalent to the seventy-third degree on our world, or about the latitude of the North Cape of Norway, which is limited to its extreme point. In other words, the canal system of Mars seems to come to an end where the population begins to grow sparse before the influence of polar desolation.

In a general way, we invite attention to the points of convergence D and E on the western hemisphere, as they seem to partake of the nature of the water-ways we have been considering, and also F on the eastern hemisphere and the same latitude. But let us take a glance at that great estuary running northward up into the land from the southern ocean, lying near the eastern verge of the eastern hemisphere. Its mouth opens southward at the tenth degree of south latitude, and it penetrates above the fortieth parallel of north latitude; at the point G, which is suggestive of a possible terminus of its navigable waters, it is entered by three canals, coming, as usual, from different directions, one of them suggesting from its crookedness that it may have been a river flowing into the estuary and forming its headwaters. Following this great water-course about 300 miles southward, we see two canals converging to a point on its southern bank; and, directly opposite, a single one, pursuing the general direction of both, starts from its northern bank, as if there were design in securing a continuous direction of the canal-journey on both sides of the great estuary. Some hundreds of miles still further southward, we find two other canals entering on the northeastern shore, that at the tenth degree of north latitude being remarkable for first entering a lake from the northward, and then, by a short canal, entering the gulf of the estuary from the lake.

If we now follow the coast line, examining carefully as we go, we shall find many of the water-ways that enter the ocean growing wider as they approach the coast-line, precisely as do our own rivers, great and small, and that every one of these natural water-ways has been connected with the canal system. We again find examples of two canals converging to a place of conjunction, and then continuing, in the general course of both, toward an objective point farther on, as pointed out by the arrows. This is so striking a feature of the economy of skilful engineering that it is very difficult to reconcile it with any other origin. If we now retrace our wanderings over the land, we can hardly help noticing that several canals radiate from common centers, some of those centers having as many as seven radiating water-ways, others six, others five, and so on, down to three. But it is also obvious, so far as we can read from the map, that they are not the locations of lakes or other natural water-ways to which an engineer might be induced to converge a system of canals for the purpose of economizing labor by gain of water-way, as in the cases already examined, and we are left to the conclusion that they are centers of population. Of this character is the point marked H, about 16° south of the equator near the verge of the western hemisphere, and also I and J, lying between the equator and 10° north; and with those as guides, others of similar character may be readily distinguished. Let us direct our attention to one of them, K, at the sixty-seventh parallel of north latitude, on the western hemisphere; then let us recall the fact that the sun moves 7° farther poleward on Mars in its summer-time than it does on our earth; then, in relation to the climatic condition of these two planets, the assumed center of population at the sixty-seventh parallel of north latitude on Mars is exactly the same as that of St. Petersburg at the sixtieth parallel on our earth, so that, assuming this point of convergence of this canal system to be a populous center upon Mars, is merely suggesting that there may be a large city on that world bearing the same relations to its climatic conditions that St. Petersburg does to ours, and that it also is the most northerly of the great cities.

Having, then, passed in review this canal system of our neighboring planet, and found it replete with evidences of design, such as characterize the science of skilful engineering on our own planet, let us assume, for sake of argument, that we have overdrawn the testimony, and that the markings have resulted from forces that accompanied the creative events of that globe. These two planets have their axes of rotation so inclined to the planes of their orbits about the sun that the alternations of their seasons are practically alike. When the sun moves northward on one or the other, the snow line recedes toward the north pole. When the sun retires from its northern summer solstice, the snow-line advances down the northern latitude, just in proportion as the source of heat recedes. The analogy between these concurrent phenomena of the two worlds is complete, and both, also, are divided into land and sea. So far, then, as the logic of facts can reach, the links of analogy are unbroken. This warrants us in assuming that the creative events of both worlds were equally analogous for "like causes produce like effects," from which it follows that the primal waters of Mars came down upon that globe from an enveloping cloud of vapor, covering its molten mineral substances, and thereby hardening them into the rock forms due to their composition, as the granite of our world hardened into its present form under like conditions. But whatever may be the mineral composition that assumes upon Mars the same geological relations that the granite does to our world, it was the primal sea-bottom of that globe, and as a sea-bottom, was covered with water long before its upheaval above the surface occurred, as in the case of our own primal sea-bottom. That this underlying sea-bottom was genuine rock formation a glance at the facts will demonstrate. Rocks and clays are all combinations of metallic elementary matter with oxygen or the other five elementary forms of the "oxygen group," but the oxygen far exceeds in the quantity of its combinations all the other four. The presence of water on Mars proves the abundant presence of oxygen, for it is an oxide of hydrogen. Metals are all forms of matter in its elementary condition, and most, if not all them, will decompose water by setting the hydrogen free and combining with the oxygen it contains; therefore, the metallic elementary forms of matter upon Mars must have entered into combination with oxygen, even if no oxidizing agent were present but water. Hence, the crust of the planet Mars is rock. The cooling of this rock sea-bottom, as in the case of our own world, caused it to contract or expand, as the case may have been, and therefore to wrinkle; the portions that bent upward rose above the surface of the overlying sea, and those that bent downward drained the displaced waters into the depressions thus formed, and they became seas, and the mandate was fulfilled in that world also, "Let the waters under the heaven be gathered together unto one place, and let the dry land appear." Forces so generated could not act with equal potency at every point, and there must be locations of greater and less resistance; therefore, parts of the wrinkling rock sea-bottom would sink deeper than others beneath the normal level, while other parts would be elevated above it to a correspondingly unequaled altitude. Hence Mars had its deep and shallow seas, its sea-level marshes, and mountains, with all sorts of intermediate relations, and the curves in several of the canals indicate that the engineers were flanking the difficulties that interpose between them and their objective point. There is nothing in the nature of the forces that upheave the land of a world from its waters that could leave such mountains on its surface as those shown by the maps; nor is it conceivable that Nature, in her methods of world-making, could leave upon her land surfaces such markings as would bear the interpretation of engineering economy without a broken link of the chain of evidence.

It has already been asserted that these assumed canals cannot be artificial, because they are 80 miles wide; but it is equally inconceivable that the forces of nature could, by the laws of accident, have constructed such an intricate system of marking, and observed an equal width in every case. The map given with the report has reduced them to 43 miles wide, and a little investigation will show that this is still greatly in excess. If, when our observer is measuring their width with his micrometer, the water should be disturbed by the slightest breeze, the light would be reflected from them at all sorts of angles, and therefore it would be spread over the micrometer lines to a much greater extent than the real width of the object under observation. But let us assume that no breeze is stirring the water. The surface then becomes a section of a polished ball, analogous to a polished glass ball, and as such its action upon light is dispersive; it therefore arrives at the earth in the character of divergent light, and must consequently occupy a width upon the micrometer greater than that actually due to an object at that distance. Hence we have probably not yet obtained the actual width of these canals.

Assuming that the weight of evidence is in favor of the belief that the markings on the maps show a great system of engineering which connects by water-ways every part of the continent of the planet with its ocean navigation, let us glance at the logical significance of such a state of things. Those who produced such a comprehensive system were not merely great designers, but they must have had instrumental means of "running their lines," "making and plotting field notes," "taking levels on the surface of a globe," and "correcting them" as we do; which implies that they are familiar with the science of mathematics. The construction of these canals implies the necessity of locks. Locks could not be constructed without a knowledge of architecture, which, of course, would not be confined within the limits of lock-building. We have an axiom that architecture and engineering require the most absolute accuracy of drawing, and merge too naturally into art to permit us to doubt that a people who could conceive such a comprehensive system of engineering would neglect the cultivation of the picturesque.

That they are navigators is proved by the fact that their entire canal system is interoceanic; for nowhere do we find a single instance of a canal that is not in direct communication with its great southern ocean, or the less expansive seas of its northern hemispheres. Look at Lake Nillicus: three of its six canals run southward, one taking the most direct route to the ocean, and two diverging to the right and left, on their way there, just enough to serve the economic purposes of the great sections of country that they traverse. Two others run direct from the lake to popular centers, one of which is in direct canal communication with the northern seas while the sixth canal from the lake makes a long stretch westward, but a few hundred miles from the lake forms a a junction with another canal, which thence proceeds in the most direct route to the northern sea.

It is also worth our while to observe the fact that the system is not based on financial economy. A glance at the map will show that the original engineering scheme, was the interpenetration of their entire circum-planetary continent with navigable water-ways, swerving from an equal division of land sections only where they could utilize natural water-ways or communicate with populous centers, which seems to prove that Mammon is not worshipped on that planet, but has been banished to this. For this great system of navigable water-ways interpenetrates every part of their world alike, making a unit of the social relations of its entire people and precluding the possibility of barbaric conditions existing on any part of their planet. Let us change its name, for it is evidently a world where "peace on earth, good will to men" is a realization, and it should no longer be called after the God of War.

DREDGING SAND AND SILT.—In *Les Annales des Ponts et Chaussées*, M. BOULE describes a form of dredger in which the removal of sand or silt is effected by an injection of compressed air instead of by suction. The machine consists of a tube passing through the water to the bottom to be dredged, and a compressed air injector placed at the bottom and at right angles to another pipe. The injector surrounds the main tube, and is fitted with a number of small mouthpieces producing a flow of a mixture of water, silt, and air up the main tube. In a trial at Saumur, on the Loire, the main tube was 4 ins. in diameter, and sand was dredged from a depth of 15 ft., lifted 5½ ft. above the water level, and finally transported to a distance of 50 ft. The compressor was of 15 horse power, which drew in 3.53 cu. ft. of air per second, and by it raised 130 cu. yds. of sand-burdened water per hour, the sand constituting from three-tenths to four-tenths of the whole volume. At Havre a 9-in. tube was used, and the depth was from 26 ft. to 30 ft. Using a compressor of the same power as at Saumur, 390 to 520 cu. yds. of silt and water were lifted per hour, the silt forming one quarter of the whole. The dredger is most efficient in soft silt, sand, or gravel, but stones weighing 22 lbs. have been removed by it, using the 9 in. tubes.

THE HOGBACK TUNNEL, of the Elk Mountain Coa & Coke Co., of Colorado, was "holed" last week. It is 976 ft. long and about 8 x 8 ft. in section, piercing the Hogback range 7,000 ft. above the sea. It is intended to convey water from the Grand river to the other side of the mountain and to develope further coal seams.

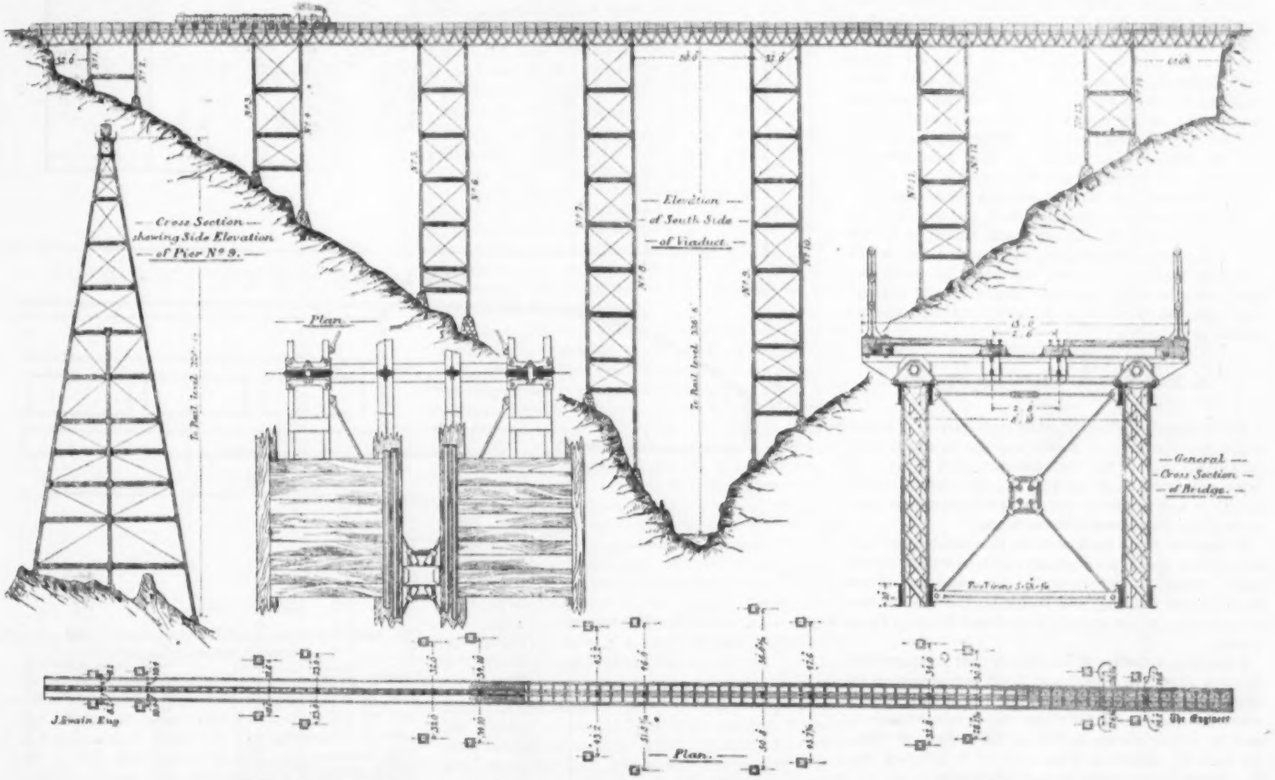
The Highest Viaduct in the World.

If counted from surface of water in the stream crossed to the rail-level, the viaduct over the river Loa, on the Antofagasta Railway in Bolivia, is the highest railway structure in the world. The cañon here spanned is 10,000 ft. above the sea, in the upper Andes. The crossing was located by Mr. JOSIAH HARDING, M. I. C. E., who also proposed the general character of the bridge, and located the piers. The following principal dimensions of this viaduct, as erected, are given in *The Engineer*, to which we are indebted for the illustration given and the material here used:

are connected by an internal cruciform diaphragm 4 ft. 8 in. long, built up of three ⅝-in. plates and four angle irons at the center, the plates serving as a splice between the flanges of the two sections of column. The base-plate for each column was a casting 3½ ft. square and 3½ in. thick with four 2½ in. anchor bolts in the corners. All lateral connections were made by gussets and diaphragm plates. All tie-bars, except horizontal ones, are in pairs provided with sleeve-nuts for adjustment to length. The highest pier had at the bottom a transverse base of 106 ft. 8 in. on the low side and 93 ft. on the up-hill side; all of the piers were 32 ft. wide throughout on the line of the bridge.

area, have a greater proportion of unbroken ground than other regions of the same area in the more sparsely populated regions of the West. Mr. JOHNSON thought that there was still room in these old States for many thousands of settlers, and that the complaints of Pennsylvania farmers of competition from the wheat raisers of Minnesota and Dakota were, when sifted down, to a very considerable extent due to their own inefficient means of reaching the markets.

To a farmer the market means the nearest railway station. But if he is 10 miles from the station, and the condition of the roads requires the expenditure of a day's labor with a team of horses to trans-


— Cross Section — showing Side Elevation of Pier N° 8.
Plan.
— Elevation — of South Side of Viaduct.
— General — Cross Section — of Bridge.
Plan.
The Engineer

Antofagasta Railway Viaduct over the river Loa, Bolivia, EDWARD WOODS, Engineer.

Length between abutments	800 ft.
Height from water to rail-level	336½ ft.
Length of longest column	314 ft. 2 ins.
Length of principal span	80 ft.
Length of pier spans	32 ft.
Width of platform over all	13 ft.
Width, c. to c. of main girders	8 ft. 10 ins.
Depth of main girder at center	7 ft. 11 ins.
Batter of outer posts	1 in 6.
Batter of piers	1 in 3.
Gage of railway	2 ft. 6 ins.
Weight of iron work	1,115 tons.
Rolling load per foot	1¼ tons.

The viaduct was erected without false works as follows: A tramway made of two strong steel wire ropes was stretched across the ravine, and on these ropes a carrying truck was hauled backward and forward by steam winches placed on the abutments. All parts of the piers were launched on this tramway and lowered to the place where wanted, each pier being built in distinct stages. As the piers were completed, the 80 ft. and 32 ft. girders were set in place in one piece by a crane brought out from England for this purpose, which ran on a special line of rails laid on the girders as they were erected. This crane had an overhanging jib of 50 ft., and was tested with a load of 12 tons, the main girders only weighing 10 tons.

The viaduct is made up of six 80 ft. spans, one 64 ft. and one 32 ft. span and seven pier spans of 32 ft. each. The main girders are of the riveted Warren type with panels 7 ft. 11 in. square. The top and bottom chords and end posts are made up of channel iron plates and lattice.

The pier columns are of the Phœnix type with four sections and 3½ by ¾ in. filling pieces between the flanges. The columns are about 15 in. in diameter out to out, and the several sections in length

The viaduct was built by the Horseley Co., of Tipton, Staffordshire, and it was erected by Mr. PETER FISHER in somewhat over nine months, with such labor as he could pick up at the port of Antofagasta. The average number of men employed was about 35. Trains run over the viaduct at the rate of 30 miles per hour.

The Value of Good Roads.

We have before referred to the good work done by the Engineers' Society of Western Pennsylvania in urging the general improvement of common roads and highway bridges in that State, and in a late issue we published the text of the road bill now pending before the Pennsylvania Legislature, and formulated by this Society. In presenting the draft of this bill to the Society for its approval, the committee in whose hands it had been placed accompanied it with some interesting statistics and statements regarding the highway system of Pennsylvania and its needs and shortcomings.

Mr. THOS. H. JOHNSON, of the committee, said that the proportion of unbroken or forest land in Pennsylvania was still very large, being 24.3 per cent. of the total area, according to the census of 1880. Of the remaining 76 per cent., nearly one-half was non-cultivated or waste land. In New York the proportion of forest to total area was 26.2, in Maryland 31.7, and in New Jersey as much as 48.8 per cent. It is therefore a fact that these States, which contain the chief commercial and manufacturing cities of the United States, and have the densest population, considering their combined

port 700 lbs. of produce to that station, it is little wonder that "farming does not pay." Good roads mean, then, a reduction of perhaps two-thirds in the cost of transport of produce, and also an increased value to the farmer's land.

Mr. JOHNSON then referred to the benefits likely to result from the intelligent location of roads, from the reduction in the length of the 90,000 miles of roads of all kinds in Pennsylvania by removing bends and kinks and unnecessary detours around favored properties, and the elimination of steep grades on such roads. Every improvement of this kind is a direct gain to the farmer and to his patrons. The total agricultural product of Pennsylvania in 1879 amounted to 6,500,000 tons, when reduced to that standard; and supposing that one-half of this was consumed upon the farm, the other half, or 3,250,000 tons, had to be hauled on wagons for distances varying from one-half to ten or more miles. Assuming that the average haul is 5 miles and that two loads per day with a two-horse team would cost $4.50, the difference in cost of moving the total market crops on clay and macadam roads, of average condition and level grades, can be figured as follows:

	Clay Road	*Macadam*
Load for two horses	1,400 lbs.	2,180 lbs.
No. of loads for 3,250,000 tons	4,643,000	2,981,000
Cost at $1.25 per load	$5,703,750	$3,726,250
Difference	$1,977,500	

This $2,000,000 is, then, the annual excess of cost entailed upon farm products by common clay roads, and it represents a sum sufficient to keep 30,000

miles of turnpike in repair at an annual expenditure of $66 per mile. Looked at in another way, it means a loss of 831,000 days' labor that might have been devoted to other useful purposes. Mr. JOHNSON thought that if the tonnage of merchandise, coal, machinery, and manufactured articles of all kinds was added to the hauling of farm products, the total loss to the community from bad roads would amount to nearly $4,000,000 per annum. He also notes that at certain seasons of the year in Pennsylvania the clay roads become altogether impracticable for loaded vehicles. This means that farm products must be marketed when the roads permit, with the result that all produce is practically sent in at one time, the market is glutted, and the price falls. And it is often also possible that the farmer who finds an impassable road lying between him and the railroad may have his barns well stocked, and may see the price of that stock steadily advancing; but as he cannot reach the market, he simply loses the opportunity of profiting by the rise. Losses from this cause may again add several millions annually to the sum already named. And $6,000,000 per annum is a very handsome percentage on $100,000,000 of invested capital.

The best estimate obtainable of the road tax annually collected in Pennsylvania amounts to the enormous sum of $4,000,000, for which there is absolutely nothing to show, unless it is most emphatically to point out the inefficiency of present methods and the folly of perpetuating this annual waste of money.

A Non-Pressure Heating System.

The accompanying illustrations show a somewhat novel system of house and car heating, now being introduced by the Combination Stove & Water Heater Co., of 143 Elm St., New York, which seems to have made so far an excellent record, and to promise considerable advantages.

The system may be described as consisting of two parts, first, the heater proper, with its connecting parts, which is substantially the same for either house or car heating, and secondly, the application or extension of the system to indirect heating from pipes.

The general nature of the heater and arrangement itself is shown in Figs. 1 and 2. It is represented in these cuts as applied to cars, but the arrangement of parts is the same for either car or house heaters, and for either steam or fire as the source of heat. In fact, the heater in Figs. 1 and 2 is adapted for the use of either fire or steam indifferently.

A water-back A surrounds about one-fourth of the circumference of a large fire-pot. Into this water-back the return pipe M enters below, while two circulating pipes B B lead from it above to the circulating vessel C, from which leads above a 2½-in. "flow pipe," not lettered, which connects with the smaller flow pipe, K, and that with any system of circulating pipes L; which latter connects finally with the return pipe M. A small air pipe N leads from the flow pipe to the supply tank T, which may be the same tank as for the Baker or any other heater, but with the plug removed and replaced by an open hood and filling nozzle, leaving the contents open to the atmosphere.

To use steam instead of fire for heating the main steam pipe, P is connected by the ½-in. pipe O with the steam supply pipe E passing down through the vertical flow pipe, into the steam heating drum D, which has a waste pipe F for the egress of the waters of condensation. These pipes and fittings are extra heavy, the drum D being of steel and having a bursting capacity of 4,000 lbs. per sq. in. It is tested to 500 lbs. The waste pipe F connects with the pipe 2 fitted at the end with the trap R. The use or non-use of this simple steam connection makes the only difference between steam and fire as a source of heat, the working of the apparatus being essentially the same whatever the source of heat.

To start the apparatus at work, water or brine is introduced through the tank T, and when filled to the water line, steam is turned on or the fire started. The tank being entirely open to the atmosphere, no pressure can exist in the pipes. The valves shown in the pipes K and O are not necessary as essential parts of the working apparatus but only for occasional convenience. An automatic thermostat apparatus may be connected to the valve at O.

In the ordinary hot water heaters of the Baker type, the pipes are sealed and often carry a very considerable pressure, which has frequently resulted in explosion. In direct heating by steam the pipes are necessarily under pressure. The heating space in these heaters, moreover, is merely a coil of very limited cubic capacity. The main idea of the device now illustrated is to obtain a circulation without pressure—that is, with the apparatus open to the atmosphere, in pipes carried several feet below the water circulator or heater, and the fundamental requirement to this end is the large and peculiarly arranged heating space. The system is the invention of Mr. G. T. BREWER, and was originally suggested, we understand, by the necessity of keeping the soil, gas, and water pipes of the elevated railway stations from freezing, which it was found impossible to do with certainty by packing only, without the application of heat.

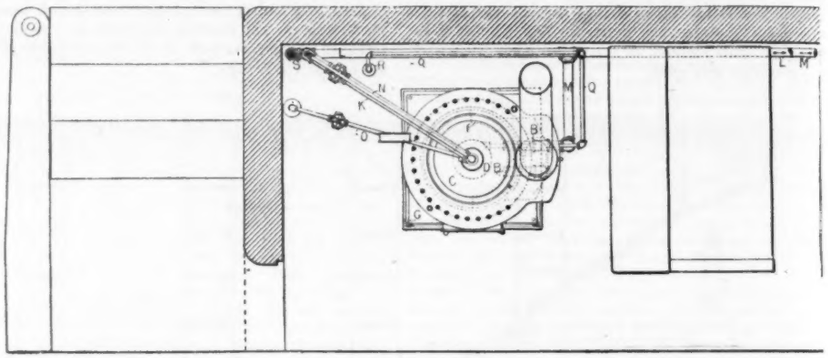


Fig. 1.—Plan.

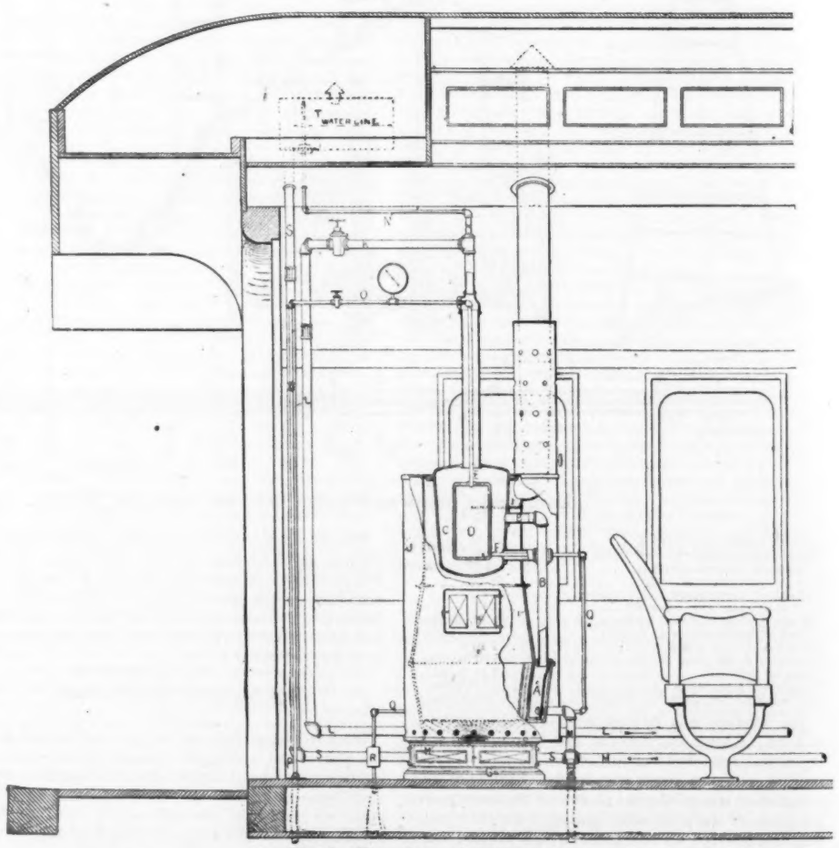


Fig. 2.—Elevation and Section.

The Non-Pressure Heating System as applied to Cars.

Mr. BREWER then made the connections shown in Fig. 3. The heater is about 54 ins. high. The pipe A is about 10 ft. above B B', and about 50 ft. above C C'. To explain, in as simple a manner as possible, how the circulation is obtained, it must be recollected that the weight of a cubic foot of wat

at 60° Fahr. is 62.37 lbs., and at 210° Fahr. 59.82 lbs., being a difference of 2.55 lbs., equal to a head of about 5.9 ft. The system of Fig. 3, being filled to the water-line shown in the expansion tank E, it being about 10 ft. above B B', there is a pressure at B B' of about 4.5 lbs. When fire is lighted and circulation takes place in the back and circulating vessel by means of the circulating pipes, the lighter hot water ascends the flow-pipe, the denser cold water in the heater and flow pipe falls into the water-back and circulates between it and the circulating vessel until all of it has risen to a high temperature, when there exists a column of water in heater and flow pipe, from B to A, somewhat less than 2.5 lbs. lighter than that in the return pipe D B', below the expansion tank.

This difference in weight causes the water to rise in C B to the water-back, and as the warm water from the expansion tank gradually and slowly passes down D B' C', and warmer water ascends, naturally when it gets to C, all the water in the system having been raised in temperature, circulation is caused and continued by the gradual displacement of the lighter hot water from the heater to the expansion tank, which is continuously re-

placed from the latter to the former through the pipes *D, B', C', C, B.* The open ¼-in. pipe on the expansion tank permits the vapor from the heated water to escape, so that no pressure will be formed.

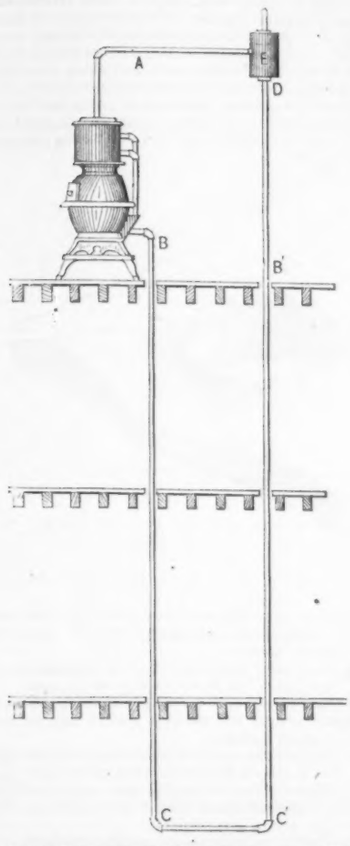


Fig. 3.—Non-Pressure Heating System, as applied to Circulation below Heaters.

On account of the circulation between the back and the circulating vessel in the heater, with the large volume of water and head obtained by the circulating vessel, steam is not generated in the back to stop the ascent of the water when cold through *C B* and into the back before *C B* becomes heated. The difference between this heater and a pipe-coil may be thus explained: When a pipe-coil is placed in a stove in the same relative position to the pipes as in Fig. 3, and fire is lighted, the water in the coil being a small volume, surrounded with a proportionately large amount of heating surface, becomes quickly and intensely heated, and to such an extent that a portion of the pipes, on account of the water leaving the surface uncovered, becomes so hot that any water coming in contact with that part is immediately turned into steam and pressure is produced, thus stopping circulation. Steam is then continuously produced, and as it blows as well into the return pipe as into the flow, if the system is closed, the water becomes ultimately heated, and the pipe coil is soon destroyed. If the water-back were only used without the circulating vessel or "water-tank," the same production of steam and pressure would be liable to occur. In the heater illustrated this defect is guarded against, and what might be called an uncommon, yet a natural, circulation has been obtained.

This method of producing circulation appears in practice to be effective whenever the open supply tank is 6 to 10 ft. higher than the heater, however far the pipes are carried below it. Of course, without some elevation of the supply tank, circulation becomes impossible; and the higher the supply, within limits, the more rapid and perfect the circulation.

The sketch given in Fig. 4 shows a practical application of this system of heating, fitted up to heat four different rooms from one stove, in such manner as to severely test the principle. This arrangement has been in use all winter at the office of the company, 143 Elm St., New York, heating four different rooms (the partitions not being shown in the cut) from one stove; and the apparatus is so arranged that either steam or fire may be used.

Having attained to this uncommon and apparently improbable point in the circulation and transmission of heat by water, the next thing was to arrange the heater so that steam or fire could be used, in order to ascertain if the circulation would be the same when steam was used as a heating medium, as when fire was applied, and whether a difference could be discerned.

The heater is 15 ft. nearer to the return bend coil and hot-water radiator on the right side than to the corner coil with manifolds on the left side of sketch. The vertical ascending main flow pipe is of 2-in. pipe and contains the ⅛ in. steam supply, thus reducing the area of the flow pipe to 2.8 sq. ins. to the first tee. This pipe passes up vertically about 7 ft. above the fire and continues of 2-in. pipe horizontally towards the south for about 10 ft., where it connects to the side outlet of a horizontal tee.

The right side of the run of this tee receives 1¼-in. pipe, which supplies the flow pipes to the return bend coil and radiator on the west side, while the left side connects to 1½-in. pipe, which is reduced to 1¼-in. pipe about 23 ft. further east and supplies the flow pipe to the manifold coil on the east side. The upper side of this main distributing tee is drilled and tapped to receive a ¼-in. air pipe which is open to the supply tank, where any drops of water caused by ebullition or the egress of air may be retained in the system.

The east and west flow pipes incline irregularly to the vertical descending pipes. The west flow pipe first supplies the return bend coil of 1-in. pipe, and then continues towards the north some 18 ft., where the descending pipe passes to the base of the radiator to which it is connected; the supply or flow then passes up the first column and down the other columns of the radiator to the return pipe. Here in the flow pipe is a "trap" or "dip" some 34 ins., which is equal to 27 diameters of 1¼-in. flow pipe.

The return pipes from the coil and radiator pass beneath the floor beams, descending about 2 ft., and thence in a horizontal pipe inclined towards the location of the heater, near which it ascends vertically about 39 ins. to one of the openings in the heater to which it is connected. The east flow pipe supplies the manifold coil and a draw-off tap, from which hot water is taken for various purposes.

The upper line of pipe in this coil is on a level with the fire in the heater. The return pipe is connected in the manner shown in the text, making a rather complicated system in several respects to be supplied from one fire. The steam supply pipe is ⅛-in. and the waste or drip pipe opening is ⅛-in. in diameter, an automatic air valve being used to regulate the outflow of the result of condensation. The boiler which supplies the steam is about 150 ft. away from the heater. The pressure of steam used is from 10 to 50 lbs. In this system as shown, there are about 200 sq. ft. of radiating surface. The total length of the four apartments is about 80 ft.

The circulation of heat is produced in the pipes by either steam or fire in 25 minutes, and the two mediums of heat, steam and fire, are left on at the same time. The system as described is said to work equally well with either steam or fire. At starting it is filled from the supply tank and no effort made to expel the air which, it is usually supposed, accumulates in such "traps," as shown in the flow and return pipes.

Without referring to the vertical ascent in the return pipes near the heater, and considering only the "traps" in the flow and return pipes, another result is claimed which is regarded as difficult of accomplishment. A "trap" or "dip" in flow or return pipes in an open hot-water circulating apparatus, equal to the diameter of the pipe, has always been supposed to retard or impede and sometimes to completely stop circulation. In this case there is an open hot-water heating apparatus with little height to the vertical ascending column or flow pipe, containing many different elements of obstruction to the circulation of water, yet circulating and transmitting heat through the pipes and radiators with no pressure in as efficient a manner, to all appearances, as has been achieved by heaters carrying pressure.

In brief, the principal advantages claimed for this heater are:

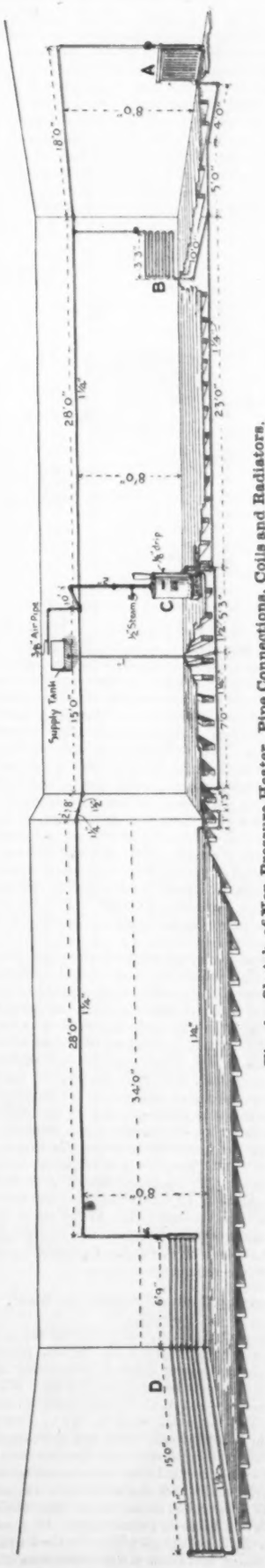


Fig. 4.—Sketch of Non-Pressure Heater, Pipe Connections, Coils and Radiators. As arranged for heating four different rooms.

The liability or possibility of any pressure in the heating pipes of a car or apartment does not exist, because the system is open to the atmosphere. For the same reason, the possible or accidental use of steam and fire at the same time cannot produce pressure in the heating pipes. The circulation and transmission of heat from the non-pressure heater to the heating pipes is not impeded or obstructed by drops in the pipes because no excessive "traps" or "dips" can necessarily exist such as shown in Fig. 4.

The supposed accumulation of air in pipes with "traps" offers no impediment or stoppage to the circulation of heat in the pipes, and the expulsion of such air requires no attention nor is any appliance or device necessary to assist such expulsion.

It appears in every way probable, for many reasons, that some such system of indirect heating will be preferred to the direct use of steam for car heating; and this device seems to have some important points in its favor, while for house heating it is obvious that it has still more decided good points. For example, a good-sized local station with four or five rooms may be heated, and heated evenly and well, from one fire; the saving over ordinary stoves being that a large part of the heat which is now wasted up the chimney, is caught on the fly, and utilized. It is not generally realized how very small a proportion of the heating power of the coal is utilized in even the best stoves and furnaces. To save a part of it, while improving the system of heating, is very desirable.

The apparatus may be set up in any room or part of the building which it is desired to heat by direct radiation, and a line of pipe, with suitable radiators thereon, may be carried into any room or part of the building, either on the same floor, above or below. When used for heating purposes, the waste of water by absorption is very small, a pint per month supplying all that is lost, as is well known. If used to give a large supply of hot water, for domestic or other purposes, it is necessary to have the tank supplied automatically, or connect to city pressure. No special care is required to manage the heater, except to fire it, and keep the fire bright, as with an ordinary stove. The standard size of stove will, in addition to heating by direct radiation the room in which it is located, supply heat to 300 sq. ft. of radiating surface, which in its turn will it, is claimed, heat about 15,000 to 20,000 cu. ft. of air space.

Drifting Tests of Structural Steel.

In our issue of April 27, we published some data for which we were indebted to Messrs. Hunt & Clapp, of the Pittsburg Testing Laboratory in regard to drifting tests for structural steel. We are now indebted to Mr. A. C. CUNNINGHAM, C. E., of Pittsburg, Pa., inspector with G. W. G. Ferris & Co., for the following additional and more detailed data, as also for the original test specimens, numbered 1, 2 and 3, from which our engravings have been prepared, and which are as faithful reproductions as our artist could make them. The inside of the holes is very brightly polished, and the lines of shading on the drawings parallel with the holes are only used where there is a distinct striation of the surface of the metal. The originals of all the test pieces which we have illustrated can be examined by those interested at this office. Mr. CUNNINGHAM'S letter in respect to the tests is as follows. We have briefly commented on the letter editorially.

In your issue of April 27, you give a description of some very excellent drift tests, the devising of which you credit to Messrs. Hunt & Clapp, of the Pittsburg Testing Laboratory.

I believe the credit for this test is due to Mr. J. J. R. CROES, chief engineer of the Suburban Rapid Transit Co., who, in March, 1888, wrote a specification governing the manufacture of some steel angles that were to be punched without reaming. A clause in this specification reads as follows:

Any with hole punched as in ordinary practice shall stand drifting to a diameter 25 per cent. greater than the original hole, without cracking, either in the periphery of the hole, or on the external edges of the piece, whether they be sheared or rolled.

I had immediate charge of the inspection of these angles, and made numerous tests upon them. The angles were made by Carnegie, Phipps & Co.

The first two or three tests showed that the increase of 25 per cent. could be got without difficulty, and I then began trying for the limit; upon reaching 73 per cent. I was unable to go any farther, as the drift would not enter a hole smaller than 11-16 in. diameter, and was 1 3-16 in. diameter at the largest part. This 73 per cent. drift was then adhered to, and the test successfully made upon the whole lot of angles. These angles were about 60,000 lbs. ultimate strength per square inch, and contained between .05 and .06 per cent. phosphorus.

Upon inquiry at the Carnegie mills, I am told that no drift tests had been made there previous to those mentioned above.

I forward you some remarkable drift tests which I have recently made at the mills mentioned as manufacturing the steel. These tests were made in duplicate, and can be repeated for those desirous of seeing them.

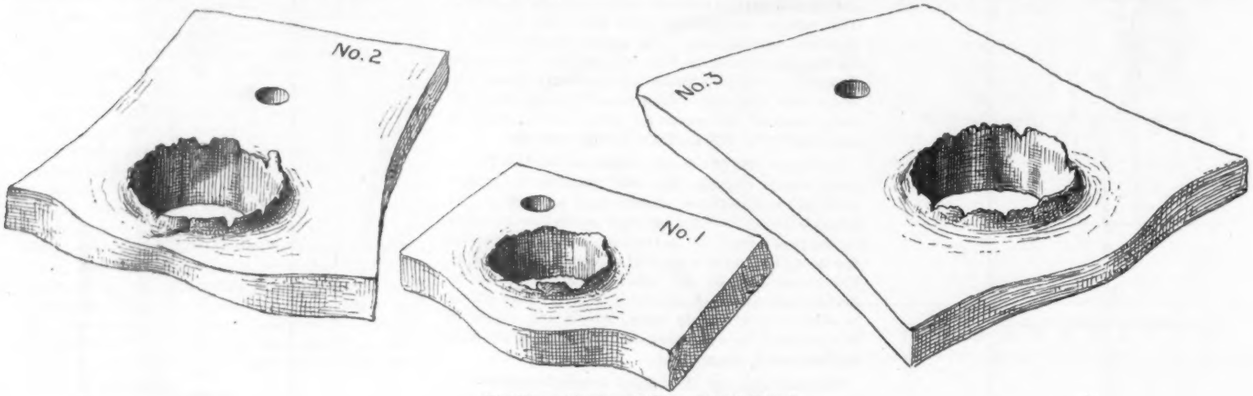
Test No. 1 is from a 24 by 9-16 in. universal steel plate, open hearth process, made by the Carbon Iron Co., Pittsburg, Pa. The tension test on this plate gave an ultimate strength of about 65,000 lbs. per sq. in., and the phosphorus was .073 per cent. The original hole was 7-16 in. diameter, punched, and the center of the hole was 1 in. from the rolled edge and 4 ins. from the sheared end. After drifting it to 1 1-2 in. diameter, an increase of 245 per cent., the specimen was sheared out, and the original sized hole punched alongside the drifted hole.

Tests Nos. 2 and 3 were made later upon a 16 by 5-8 in. universal steel plate, basic open hearth process, made by Carnegie, Phipps & Co., Pittsburg, Pa. The ultimate strength of this plate was about 46,000 lbs. per sq. in., and the phosphorus .006 per cent. The center of the 7-16 in. punched hole in test No. 2 was 1 1-2 ins. from the rolled edge, and about 2 ins. from the sheared end. Notice that when crack appeared, the metal had begun to reduce at this point, the same as with a tension test. The three drifts that were used in making this test were driven from opposite directions, forming a fin on each side of the drifted hole.

Test No. 3 is from the same plate as test No. 2, and in this the center of the 7-16 in. punched hole was placed 2 ins. from the rolled edge, and the drifts driven entirely in one direction. The 2-in. drifted hole gives an enlargement of 357 per cent. on the original diameter.

I enclose you sketches of three drifts similar to those used in making the above tests, and which I have found to be quite convenient, and to give good results. Nos. 1 and 2 will be sufficient for most purposes, and No. 3 can be used in conjunction with them for extra large drifts.

The maximum drift with No. 1 on a 7-16 in. hole will be 128 per cent.



Drifting Tests of Structural Steel.

The maximum drift with No. 2 on a 9-16 in. hole will be 122 per cent. and in conjunction with No. 1 on a 7-16 in. hole, 186 per cent.

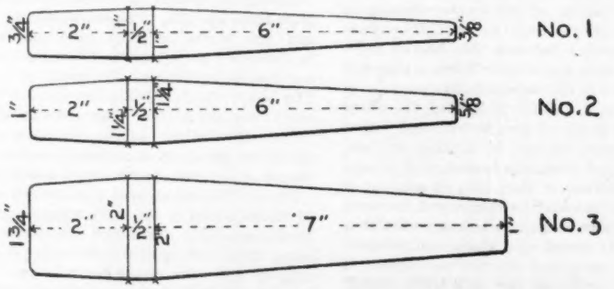
The maximum drift with No. 3 in conjunction with Nos. 1 and 2 on a 7-16 in. hole will be 357 per cent.

Ordinary tests may be made upon an anvil, and the drift sledged through, but the best results may be had by using a steam hammer.

The test piece should be supported on the under side by a surface having a hole with a rounded edge, slightly larger than the punched hole to start with, and the size of holes increased as the drift is driven through; blank nuts make a very good support.

The drift, in starting, should be entered from the lower side of the punched hole on account of the taper in the hole and in order that the fin left in punching may be drawn in by the drift.

Successful drifts are the more difficult to make as the hole approaches a sheared edge, especially when sheared across the direction of rolling; and in these cases, the cracks start in the sheared edges, and not in the hole itself.



Drifts used for Drifting Tests of Structural Steel.

The general nature of the samples above referred to, Nos. 1, 2 and 3, can be understood from the engravings herewith, which should be compared with those published in our issue of April 27. The burrs are much more decided and thicker than in the sample illustrated April 27, and the edge of the metal more broken in all three of the test pieces. Test piece No. 1, as shown above, is the least so, and No. 3 the most so. The tests indicate metal of a very superior quality.

THE MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE line is to enter the competition for passenger traffic as well as freight. A through vestibule train from Minneapolis to Montreal is to be put on at once and is expected to make the run from Minneapolis to the Sault, 455 miles, in 15 hours. The Canadian Pacific will make close connections at this point. The total distance, Minneapolis to Montreal, is 1,120 miles.

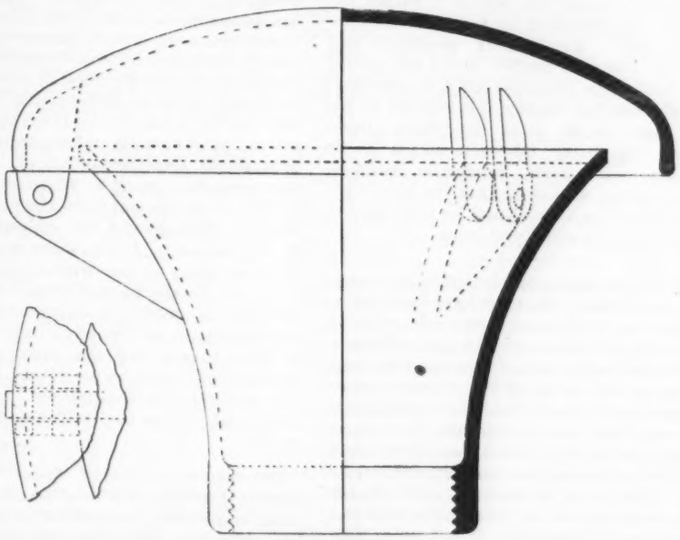
CORRESPONDENCE.

An Overflow Problem.

CHICAGO, Ill., April 20, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

Will you kindly publish the inclosed cut of a cast-iron overflow head and the following data relative to the overflow from an elevator tank on the upper floor of one of the high buildings here, asking that some of your readers send in their opinion as to the capacity of the overflow.



Tank Overflow.

The weir of the overflow is located within a few inches of the top of the tank, establishing the water line, which in this case is at an elevation of 2·5 ft. above the surface of the water in the discharge cistern in the basement.

The overflow pipe is 8-in. standard steam pipe, running as follows, to wit: 8 ft. vertically inside the tank, 30 ft. horizontally (passing through the side of the tank), 54 ft. vertically, 210 ft. horizontally, 142 ft. vertically to the basement ceiling, 130 ft. horizontally along the basement ceiling, and then 11 ft. vertically to the discharge cistern, making the total horizontal distance 360 ft. and the total vertical distance or fall 215 ft. There are in all fifteen sweep elbows in the run; the radius of the bend is 9¾ ins.

Now, when the water has raised high enough to flow over the weir, what is the total head, and what will be the discharge in gallons per minute?

I have used this overflow head and a formula for capacity of discharge, for a good many years, in eight and ten story buildings, and in all cases got the most satisfactory results; but inasmuch as the size of the overflow in this case has been questioned a great deal more than at any time before, I would like to fortify the position taken by myself with opinions of some of your readers who might care to look into the problem.

I. LINCOLN, JR.

Concerning the Drifting Test for Steel Angle Bars.

TROY, N. Y., April 30, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

It might be inferred from some remarks in the article on "A Drifting Test for Steel Angle Bars" in your issue of April 27, that the steel used in the Hawk Street viaduct was to be punched for riveting without being reamed. This is not the case, medium steel, as in Cooper's specifications, being used in the manner prescribed there.

Though gratifying as evidence of the quality of structural steel now being made, the number of such satisfactory experiments as the one described is not sufficient, in the opinion of the writer, to guarantee safe results in the use of material of this quality without drilling or reaming.

PALMER C. RICKETTS.

Velocity Formulæ for Sewers, etc.

BERLIN, April 29, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

In No. 50 of your journal, dated Dec. 15, 1888, I find Mr. HERING'S formula for the mean velocity of sewage flow in glazed pipes, etc. I have no objection to the derivation of this formula from Mr. KUTTER'S excellent formula, and am glad to see that Mr. HERING has used this method for some years, as I have also done. But I would ask leave to state that I myself first *published* in German periodicals that particular method of development of good and simple formulæ for several kinds of water-carriers.

As a matter of interesting comparison, I send my formulæ herewith, and call particular attention to the *n* preferred by Mr. HERING and myself. In 1886 I published in No. 45 of the *Landes Cultur Zeitung* the following formulæ for open water-courses in *earth*, such as ditches, creeks, small rivers, etc.:

A. Bed in very good condition ($n = 0{,}025$)

$$v = \frac{63.R\sqrt{F}}{\sqrt{R} + 0.6}$$

B. Bed not wholly regular, some stones and aquatic plants ($n = 0.030$)

$$v = \frac{55.5.R.\sqrt{F}}{\sqrt{R} + 0.7}$$

C. Bed irregular, seldom emptied, with detritus, plants, etc. ($n = 0.035$.)

$$v = \frac{50.4.R.\sqrt{F}}{\sqrt{R} + 0.8}$$

Further than these I published in our German *Sanitary Engineer*, Nos. 1 and 2, 1887, the following formulæ giving reasons and data for the choice of a special *n*:

I, II. Pure water in new, iron, asphalt-coated pipes. $n = 0.01075$, with d less than 0.50 m.; and $n = 0{,}012$, with d greater than 0.50 m.

I. $$v = \frac{58\,d\sqrt{F}}{\sqrt{d} + 0.5}$$ II. $$v = \frac{53\,d\sqrt{F}}{\sqrt{d} + 0.56}$$

III. Sewage in glazed pipes ($n = 0.011$).

$$v = \frac{57\,d\sqrt{F}}{\frac{1}{2}\sqrt{d} + 0.513} \text{ or } v = \frac{114\,R\sqrt{F}}{\sqrt{R} + 0.256}$$

IV. Sewage in brick sewers ($n = 0.0125$).

$$v = \frac{103.7\,R\sqrt{F}}{\sqrt{R} + 0.3}$$

V. VI. Sewage in iron, asphalted pipes.
$n = 0.0115$, with d less than 0,50 m., and
$n = 0.0125$, with d greater than 0.50 m.

V. $$v = \frac{55\,d\sqrt{F}}{\sqrt{d} + 0.54}$$ VI. $$v = \frac{51.5\,d\sqrt{F}}{\sqrt{d} + 0.586}$$

By substituting in KUTTER'S complicated formula the *n* of these formulæ, you will obtain the *same results* for *v* as here given in much simpler form.

In the above formulæ the notation is as follows, all measurements being metrical:

v = velocity per second
d = diameter of pipe
R = hydraulic radius
F = slope of water surface.

In conclusion I would state that in recent experiments at Warsaw, using these and the formulæ of other authors, the formula No. IV. was found to best correspond with actual results. Yours very truly,

M. KNAUFF.

[In respect to Mr. KNAUFF'S claim that he first published the formula for the mean velocity in sewers, reprinted in our issue of Dec. 15, as we understand the facts, Messrs. LEVAN, FLYNN and HARTFORD were all ahead of him, as far as publication is concerned, while Mr. HERING made no claim for originality, the only difference between these formulæ lying in the numerical values for the coefficients, Mr. HERING having communicated his values simply as substantiated by nine years' experience.

To sum up the facts as we understand them: KUTTER published in 1869:

$$v = \frac{a\,R\sqrt{s}}{C + \sqrt{R}}$$

Values of coefficients a and C, as independently suggested by various writers have been:

LEVAN circulated in 1878:	$a = 182$, $C = 0.55$.
FLYNN published in February, 1885:	$a = 189$, $C = 0.58$.
HARTFORD published in March, 1885:	$a = 176$, $C = 0.65$.
KNAUFF published in 1886:	$a = 188$, $C = 0.55$.
HERING published in 1888:	$a = 188$, $C = 0.64$.

Probably any one of these values is within the error of ordinary gauging of sewage flow.—ED. ENG. NEWS.]

The Perkins "Railroad Chair" or Tie-Plate.

PORTSMOUTH, N. H., May 7, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

By American Express I send you two of the "Perkins Railroad Rail Chairs," size, 5 x 6½ ins., that have been in continual use on a road of large traffic over four years; the wood plate was soft and sappy and not suitable. Please examine the samples for rot or indications of decay. Their preservation I attribute to air being sucked in and forced out between the tie and wood plate by every passing train, a result which cannot take place with large and heavy timbers, or on trestles of bridges. I have yet to see the first bent spike from "side thrusts" or any other cause, that have been driven through my chair, or any lateral movement of chairs, and I doubt if either can occur while the weight of train is on the chair. The Perkins chair can also be utilized with advantage and economy on old ties after the cut and decayed section has been suitably adzed out to give a fair bearing surface for the chair to rest on. As to the discussion in the NEWS of the merits of different tie-plates, and noticeably those of the Perkins and so-called Servis plates, I wish, and do say, that I invented the so-called Servis tie-plate in 1879, and had some of them manufactured early in 1880, but the objections to its use were several. Two I will mention, viz., the cutting of the groove in tie for local rot to start from, as it did not occur to me then (or now) that it was possible to find one tie in a hundred with grain of wood so straight but that the channel or flanges of a metal plate would cut off more or less of the fibres and grains of the wood, not on the surface merely, but would continue to cut and burn the fibres and grains to the whole depth the flanges were driven into the tie, say 1¼ ins. The second objection is the accumulation of moisture on the plate, confined as it must be, which becomes a source of rot, on which point the so-called owners of the plate maintain a lamb-like silence, and to me the reason is obvious.

The editorial inquiry in the NEWS, of 13th inst., "If the two wood surfaces coming together does not cause rot, then why is it (the Perkins chair) not in more general use?" I will answer: *Only* from want of capital and a manager with push and influence. Many and repeated have been the inquiries of railway supply men and superintendents: "What can the chair be furnished for by the quantity, furnished for any width of rail either of soft or hard wood plates?" to which I could only reply, that I was not prepared to give figures. Recently I have been in correspondence with a party in your city with a view to their purchasing a controlling interest in the two patents covering the chair; and if they don't push me so hard as to require me to give them a "bonus" for the privilege of granting the control, I shall expect to witness before many years millions of the Perkins chairs in use on new and old ties of the leading roads in the country.

Very truly yours,

M. R. PERKINS.

[The samples sent us are in most excellent and unexceptionable condition, and if they truly represent the average results obtainable, make a strong case for the plates. As Mr. PERKINS justly remarks, however, nothing can be introduced without pushing it.—ED. ENG. NEWS.]

A TEST FOR THE PURITY OF DRINKING WATER is given as follows by Prof. ANGELL of the Michigan University: "Dissolve about half a teaspoonful of the purest white sugar in a pint bottle completely full of the water to be tested, and tightly stopped; expose it to daylight and a temperature up to 70° Fahr. After a day or two examine, holding the bottle against something black, for floating specks, which will betray the presence of organic matter in considerable proportion."

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GEO. H. FROST . . . . . BUSINESS MANAGER

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club, Philadelphia, Pa.—Regular meeting, May 18. Secy., Howard Murphy, 1122 Girard St.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, May 21. Secy., S. M. Wickersham, Penn Bldg.

American Institute of Electrical Engineers.—Annual meeting, May 21 and 22, at 127 E 23d. St., New York.

Engineers' Club of Kansas City, Mo.—Regular meeting, June 3. "Sewerage for O. K. Creek District," W. Kierstead and A. J. Mason. Secy., Kenneth Allen, 310 Baird Building.

Civil Engineers' Society of St. Paul, Minn.—Regular meeting, June 3. Secy., Geo. L. Wilson, Asst. City Engineer.

Denver Society of Civil Engineers.—Regular meeting, June 4. Secy., W. W. Follett, Tremont Block.

Western Society of Engineers, Chicago, Ill.—Regular meeting, June 5. Secy., John W. Weston, Gaff Building.

Engineers' Club of St. Louis, Mo.—Regular meeting, June 5, "The Olive St. Cable Line," W. Bartlett; "Compound Engines," E. E. Furney. Secy., Wm. H. Bryan, 709 Market St.

American Society of Civil Engineers, New York.—Regular meeting, June 5. Secy., John Bogart, 127 E. 23d St.

Association of Civil Engineers, Dallas, Tex.—Regular meeting, June 7. Secy., E. K. Smoot, 15 No. Jefferson St.

Civil Engineers' Club of Cleveland, O.—Regular meeting, June 11. Secy., James Ritchie, Case Library Rooms.

New England Railway Club, Boston, Mass.—Regular meeting, June 12. Boston & Albany passenger station.

New England Water-Works Association.—Annual meeting at Fall River, Mass., June 12, 13, 14. Secy., R. C. P. Coggeshall, New Bedford, Mass.

American Railway Master Mechanics' Association.—The annual meeting will be held at Niagara Falls, N. Y., beginning June 18. Secy., Angus Sinclair, 140 Nassau St., New York.

Boston Society of Civil Engineers.—Regular meeting, June 19. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting, June 20. Rooms, 113 Liberty St., New York City.

Master Car-Builders' Association.—The annual meeting will be held at Saratoga Springs, N. Y., June 26. Secy., J. W. Cloud, Buffalo, N. Y.

WE print in another column a very practical and interesting letter from Mr. A. C. CUNNINGHAM, C. E., inspector with G. W. G. Ferris & Co., on the subject of drifting tests of steel, which gives details for tests with great fullness, and in conjunction with the details supplied by Messrs. Hunt & Clapp in our issue of April 27, affords abundant means for adding this to the recognized and customary test. It appears to us that the test is good enough and simple enough to make it a very desirable addition. Mr. CUNNINGHAM states that the first suggestion of the test came from Mr. J. J. R. CROES, but there will probably be little disposition to dispute on the question of priority of suggestion; very likely many individuals in various parts of the world have suggested, and to some extent used it, independently. By whomsoever suggested and developed, we are satisfied the test is one of great merit, imitating, as it does, very correctly the actual nature of the destructive strains to which the metal is subjected in practice, while exceedingly simple and cheap.

The substance of the test seems a particularly good one for boiler steel, especially when the rivet holes are punched and not afterwards reamed out, which is rather the rule than the exception in American locomotive practice. Any master mechanic can apply this test very readily, and it will afford him, after a little experimenting, a quick and reliable means of testing the quality of his boiler plate in its most important single quality. Mr. HUNT, however, in his letter published last week, especially cautions readers against assuming that the test is intended or used as a substitute for reaming out punched holes in structural work.

WE desire to pass along a suggestion made to us by a railway officer of long experience, who gained a lively sense of the value of sand bags by experience as an engineer officer in the "late unpleasantness," that in no way can a superintendent or engineer of maintenance of way gain such peace of mind at trifling cost as by supplying his section men in advance with a liberal supply of sand bags, to be used in protecting structures or track imperilled by water. The bags themselves cost almost nothing, and may be of any coarse material which is locally cheapest. If not used, they cost nothing except the interest on the small investment; but if need comes to use them, they are the quickest and most effective of all devices for stopping leaks and undesired water channels. They are, of course, especially useful on new roads whose normal regimen is not very well established, but they are liable to come in useful almost anywhere. Enough of the sacks can be carried on a hand car to fill a very large gap when filled with earth, and the officer to whom we are indebted for the suggestion has within the last ten years saved many structures and washouts by means of them. While some old and well consolidated roads might not find the advantage worth the cost and space, all the newer roads would be very likely to find it of value almost every year, and the "newer roads," if we include by that term all less than ten years old, include half the mileage of the United States.

As we foresaw, in lately referring to the movement to deprive non-resident members of the Engineers' Club of Philadelphia of the right of voting, this objectionable amendment to the by-laws was lost by five votes against it to one in its favor. In fact, every one of the proposed ten amendments to the constitution and by-laws failed to pass, though several of them would have been proper enough. This is a severe rebuke to the promoters of the proposed radical change in policy, and it is hardly probable that they will again attempt to force upon the Club a policy that can only be ascribed to personal pique or to a strange lapse of common wisdom in regard to the management of an organization of which they themselves are members. The great majority of the voters very properly looked upon the change proposed as suicidal in effect and as opposed to the welfare of a club in which all have an interest, and they acted accordingly, as the vote showed.

THE movement for the abolition of Sunday work on railway lines is rapidly gaining strength. The reform seems to be a spontaneous one, and to be due rather to a substantially unanimous desire on the part of railway men of every grade to bring it about than to any organized crusade against Sabbath breaking. There is food for reflection in the fact that this reform, which a large portion of "the public" has so long urged upon the wicked railway corporations, "has been made possible at this time by the harmony and the partial cessation of the wars of competition between the various companies." Railway men are perhaps not more fond of making their day of rest a day of toil than men engaged in other vocations; but, as President HENRY B. LEDYARD, of the Michigan Central, recently said, the stress of competition between the different lines has forced them to run Sunday trains; for the additional convenience to shippers which such trains afford, if offered by one competitor, must be offered by all.

Just at the present time the principal lines between Chicago and the seaboard are working in harmony. Competition among them is far from being as intense as a year ago at this time, and the stoppage of freight traffic on the Sabbath is generally acquiesced in. Those who believe in unlimited railway competition as the panacea for the evils of "railway monopolies" must be interested in determining how far this competition has thus far been to blame for the evil of Sunday railway traffic.

THE current number of *Engineering* (May 3, 1889) is probably the most remarkable issue of an engineering periodical, as respects size and contents, which has ever appeared, and vividly impresses us with the fact that we have still to grow a little before we can claim to represent the vast field of American engineering as completely as *Engineering* and its colleague, *The Engineer*, represent English engineering. The number is modestly labeled "Double Number, Paris Exposition, 1889," but it is in reality a more than quadruple number, the reading pages numbering 104, against the usual 24, while the advertising pages reach the great total of 136 (80 of them in a special supplement), making the magnificent aggregate of **240 pages** of the size of this journal, all in a single issue. We have this week been compelled to increase our own regular advertising space to 36 pages, and have at intervals published special issues of 16 to 20 pages more, which is a rather gratifying growth from the few pages which we published two or three years ago, as any reader may see in consulting his files; but this issue of *Engineering* makes our journal seem small indeed. We can only congratulate our contemporary on its successful enterprise, and remind our countrymen that it concerns their credit and interest as much as it does ours, that American engineering should be as fully represented, and that it will not be so represented until our engineering journals are as much larger than the English as the English are now larger than ours. The vast size and industrial activity of this country should, ere long, result in making this or some other more enterprising and worthy journal the leading engineering journal of the world; but at present we can only take off our hat to our English contemporary, and wish it all success.

IT is confidently expected that as many as 15,000,000 admission tickets will be sold to visitors to the Paris Exposition between May 6 and Oct. 31, 178 days, or about 84,000 per day, and this number may be largely exceeded, as 13,000,000 visited the Exposition of 1878, which was far less attractive. Unlike that exposition and our own Centennial and all preceding expositions, which were held when electric

lighting on a large scale was not, this will be open at night and be brilliantly illuminated, following the example of the various minor exhibitions which have been held since 1881, and their experience seems to warrant the conclusion that the attendance will be enormously increased thereby. The most conspicuous single feature by far, as *Engineering* remarks, is

> the Eiffel tower, that bitterly abused triumph of the engineer, to define the practical uses of which the imagination has to be strained, that dominates the surrounding neighborhood, and follows the visitor about the grounds so that he can never get away from it. A unique *chef d'œuvre* of construction—until the Americans surpass it—the stupendous lights in its lantern will fling down their beams from a height of 1,000 ft., and prove an irresistible beacon to bring Paris to its feet every night.

But despite the now expected enormous attendance there will be an enormous cash deficit, so far as direct returns are concerned, the true balance of profit coming rather from the money left by visitors, the gratification of national pride, and the stimulus to national industries and trade. Taking these also into account, beyond doubt the exposition, like most others which have preceded it, will be worth far more than its cost. We shall endeavor to keep our readers fully informed of all matters concerning it of real technical interest; to describe it with the fulness of the foreign journals would probably be profitable to neither our readers or ourselves.

THE influence of a better water supply upon the health of a community is remarkably illustrated in the experience of the town of Havre de Grace, Maryland. In times past the only available water supply was from wells within the town limits, and for many years the town had been notorious for the prevalence of malarial diseases, usually ascribed to the situation of the town on the banks of the Susquehanna river and to the fact that it lies within a so-called malarial district. In 1883-84, water-works were built and the supply taken from the Susquehanna river, and the use of well-water was abandoned. As an immediate consequence, for which he can in no otherwise account than by the change from well to river water, Dr. COCHRAN, the leading physician of Havre de Grace, reports that whereas three years ago he usually treated about seventy-five cases of shaking chills daily, he now has scarcely a single case. The town site is certainly the same, and the river, tide-water, and surrounding natural conditions remain unchanged; but the one change is that this town of several thousand inhabitants has suddenly, upon the introduction of a better water-supply, become singularly free from the one special disease which was so lately and for so long a time previously prevalent. Account for it as you please, the results at Havre de Grace are well worth noting by other towns in the United States which now experience what that town did in the past, and by a similar remedy they may meet with similar relief.

A CORRESPONDENT recently sent us a notice announcing a vacancy on a corps which he was anxious to fill with the best man available, and he states the result to us in the following words:

> Permit me to congratulate you on the circulation of the NEWS. Since the insertion of that little notice I have had letters from Canada to Louisville and from New York to California. I shall not be surprised to receive applications shortly from the other side. I have found the selected applicant, so far, a very good man. Accept my best thanks.

How far better and fairer this, than to fill such a position hap-hazard from the one or two immediately accessible men! For every such vacancy there are dozens or hundreds of qualified candidates, who only need to know of it to apply for it, and among them, in almost every case, will be found men better qualified for and more deserving of the appointment than any previously known. When it becomes the general practice to give every man a chance in this way, one of the greatest drawbacks to engineering as a profession will have been removed; and every man owes it to himself, his employers, and his younger professional brethren to do what he can to remove it, both by giving public notice of vacancies for which just the right man is not at hand, and by examining the notices of those seeking engagements, among which he will often find very desirable candidates.

IN a late interview with a correspondent of *The Globe*, Mr. H. B. SLAVEN, president of the American Dredging Co., makes the remark that if France ever completes the Panama canal, the money necessary will be raised purely upon sentiment and the *amour propre* of the French people rather than upon any business basis. This will undoubtedly be the only reason for ever resurrecting the Panama canal. The work has already cost about $259,000,000, and a fair estimate for its completion would double this sum. Commercially, therefore, it would never pay a return upon the investment. But the French investor is a somewhat unreasoning creature, and the fact that an American rival canal is being pushed with American vigor at Nicaragua may so stir up his pride that he will again pour out his savings in the attempt to complete a work commenced by Frenchmen, simply because it is French and regardless of personal consequences. But if it is to be finished, delays of any kind are dangerous; a tropical climate and Chagres floods are mighty levellers of the works of man, and but a short time will be sufficient to practically undo the work of excavation that has cost millions.

As we published the "Ludington Test" between the Rand and the Sergeant rock-drills in our reading columns, it seems only justice to call the attention of such readers as may study only the inside of our paper to the rock-drill tests between the same parties made at the Morris Mines, and now given in full in our advertising columns. Of the merits of the two machines, our readers must judge for themselves. Both parties have good drills, and if competition will result in improvement to either, the user of drills is the gainer, and in the end the most enterprising manufacturer will also share in this gain. The method used by the Ingersoll-Sergeant people to point out the relative effects of the blows by a photo-reproduction of the cuttings from each drill is ingenious and novel.

The Railway Systems of the Northwest.

II.

The four secondary systems of the Northwest were indicated on our map in last week's issue by broken lines. They are the Northern Pacific and St. Paul, Minneapolis & Manitoba systems, lying in northern Minnesota and North Dakota; the Union Pacific, extending from Omaha westward; and the Illinois Central, in Illinois and northern Iowa. It should not be understood that, either in extent or importance, these systems are accounted inferior to the four primary systems described last week. But each of them has a large portion of its mileage beyond the limits of the Northwestern groups of States, and as Northwestern systems, therefore, they take second rank to those described last week.

THE NORTHERN PACIFIC.

This system extends from eastern termini at Duluth, Ashland, and St. Paul, west to Tacoma and Seattle, Washington Territory, and to Portland, Ore.

From Ashland to Portland is a distance of 2,120 miles, and from St. Paul to Portland is 2,086 miles. The total extent of the system is 3,425 miles, of which 1,620 miles lies in Wisconsin, Minnesota, and Dakota, and is shown upon our map. The transcontinental line is soon to be shortened about 50 miles by a cut-off, just placed under construction, running northwest from Little Falls, Minn., to the main line. The branches shown upon our map are located in the productive wheat district of Minnesota and Dakota and most of them are of merely local importance. The branch which leaves the main line at Winnipeg Jc. runs north to the international boundary and connects there with the Northern Pacific & Manitoba Railroad. This is now in operation to Winnipeg, and is to be extended to a junction with the Manitoba & Northwestern at Portage la Prairie, and to Brandon and various other points in the province of Manitoba. This mileage is not included as part of the Northern Pacific system. The relations between the two companies are close, however, and it is generally understood that the parties who control the Northern Pacific & Manitoba are at work in the interest of the Northern Pacific company. It seems altogether likely that the new system will furnish a heavy traffic, especially at certain seasons of the year, to the Northern Pacific line from the boundary to market points at Duluth and Minneapolis. The branches of the system in Montana, Washington, and northern Idaho are of more importance than those on the eastern portion of the systems, with the exception of the branch to the international boundary, just referred to. These western lines of the system we shall discuss at length in connection with our map of the Pacific Coast systems.

The Northern Pacific company was chartered by Congress in 1864, but actual construction did not begin till 1870. About 550 miles of the main line had been completed when the panic of 1873 threw the company into bankruptcy. In 1879 the reorganized company again took up the work, and the transcontinental line was completed Aug. 22, 1883. Connection with the Pacific coast was then made over the Oregon Railway & Navigation Co.'s line from Wallula Junction to Portland. Work was then begun on the Cascade division, and regular trains began running through to Tacoma, crossing the Cascade range by the switchback, on July 1, 1887. The tunnel through the range was finished a year later. The branch lines of the system have been built and acquired since 1882.

The financial history of the company has been a succession of ups and downs. Pushed at the start with the enthusiasm which was a feature of railway enterprises a score of years ago, its sudden downfall precipitated the great panic of 1873. The unfortunates who went down in that time of financial ruin found no words severe enough to condemn the scheme which had brought such calamity. There were not wanting those, however, even then, who believed that eventually the road would be finished and would prove a profitable line. When the work was pushed forward in 1879 and the years following, great hopes were entertained of its success, but it is only within the past year that the company has begun to make for itself a good reputation and excite the hopes of its stockholders. The result of the system's operations in 1888 were as follows:

	1888.	Incr. over '87.
Gross earnings	$15,846,227	$3,056,879
Operating expenses and taxes	9,025,506	2,120,791
Net earnings	$6,820,731	$935,900

For the fiscal year 1883-4 the receipts were $11,893,140. They decreased in the next year, rose to about the same point in 1886, gained a million in the next year, and as seen above, made a sudden jump of over three millions in 1888. It is believed that this is due to an actual and permanent growth of traffic, principally due to the rapid growth and development of its tributary territory in Montana and Washington.

Last week the company closed an important traffic contract with the Wisconsin Central company under the terms of which the Northern Pacific system is practically extended to Chicago, so that through passenger trains and through freight shipments can be sent from Chicago to any point on the line. Great benefits are hoped from this new move, but are still somewhat problematical.

The extension just placed under contract by the company has already been referred to. The most important additions likely to be made to the eastern lines of the system at an early day are the extensions in Manitoba of the Northern Pacific & Manitoba lines, and possibly some further extension in North Dakota.

THE ST. PAUL, MINNEAPOLIS & MANITOBA.

This system has now a total extent of 3,286 miles, slightly less than its chief competitor, the Northern Pacific. Its system of lines in Minnesota and Dakota, however, is of considerably greater extent than that of the Northern Pacific. The main line of the system now extends from St. Paul and Duluth northwest to the Dakota State line, and thence due west across Dakota and the eastern half of Montana along a line about 75 miles south of the international boundary, to a terminus at Butte, Montana, 1,245 miles from St. Paul and 1,304 miles from Duluth. A second main line parallels the first to a point in northeastern Dakota, and a line at right angles to these runs from Duluth southwest to Sioux Falls, Dakota, 343 miles. Two branches run to the international boundary connecting there with lines of the Canadian Pacific system, and three other branches are completed to within a few miles of the boundary.

This system has acquired importance only within the last few years. In 1880 the company operated but 650 miles of railway. In 1885 the system had increased to 1,460 miles; and since that time, the mileage has nearly doubled, reaching now 3,286 miles, as already stated. The most important work yet undertaken by the company was the construction in 1887-8 of the long line opening up the upper Missouri and Milk river valleys and giving Helena and the chief mining districts of Montana a new outlet to the East. On May 1, 1888, 19,000,000 acres of land adjacent to this line, a tract nearly as large as the State of Indiana, was opened for settlement by the Government. It is expected that the settlement and development of this region will bring the company ample returns for its expenditure in building the Great Falls extension.

In mineral wealth, too, Montana promises to be one of the richest of the States, and the branches which this system has pushed out to the mining districts are already securing a good traffic. Helena has now a population of 15,000 and is the richest city of its size in the world. The Butte mining district produced in 1888 about $34,000,000 worth of gold, silver, and and copper.

The most important work of last year was the completion of the line from Sioux Falls, Dak., to a terminus on Lake Superior, securing a lake-port terminus for the lines of the system. The projected extensions of the system are numerous. The Duluth & Sioux Falls line is likely to be extended on southwest to Yankton and Sioux City, and perhaps into Nebraska. The branches now terminating at Aberdeen and Huron are likely to be extended to and across the Missouri to tap the Sioux Indian reservation. Various short local branches will be built as required to increase and hold the local traffic in Minnesota and Dakota. A cut-off is to be built soon to shorten the distance from St. Paul to Duluth. The company has made extensive surveys through the forests of northeastern Minnesota and a line has been located from Crookston southwest, which will probably run by the most direct practicable route to Duluth, thus giving the northern portion of the system a short route to that point. A fleet of fast propellers has been built to ply between Duluth and Buffalo, and ample elevators, storehouses, and terminal facilities have been erected at Duluth. Of almost all the lines of the system it is true that the natural outlet is via Lake Superior; and the contemplated extensions will shorten the route and facilitate the flow of traffic in this direction. Of the probable extensions in Montana we shall speak more fully in connection with our map of the Pacific systems, only mentioning now the probability that at an early date the system will be pushed through to obtain independent connection with the Pacific coast points.

The company's gross receipts in 1888 were $9,561,806 and operating expenses and taxes were $5,419,986, the net earnings being sufficient to pay all fixed charges, a 6 per cent. dividend, and leave a handsome surplus.

THE UNION PACIFIC.

Of the 6,644 miles comprised in this system, only about one-fourth can properly be considered as Northwestern mileage. The system is properly classed among the Pacific lines and will be considered more fully in connection with the map of that section. The lines in Nebraska, shown on our map, comprise the original Union Pacific railway from Omaha west to Cheyenne, Wyo., 520 miles, five branches which join the main line at Columbus and Grand Island, and the lines of the St. Joseph & Grand Island system, 454 miles in extent, lying in southeastern Nebraska. The company was first in the field in Nebraska, but it left to others the work of building branches and feeders to foster local development, and the few branches it has in the State were most of them built after rivals had the territory pretty well pre-empted. Some work has been planned for a further extension of several of these Nebraska branches, and a considerable amount of finished grade still lacks rails; but construction has been for many months at a standstill upon these branches, and there is no present prospect of its resumption. Talk is frequently heard of an extension of the system to Chicago; but there seems no reason to expect that this will be done or that to do it would be of any advantage to the company. From Omaha to Chicago there are four direct lines, controlled by the Burlington, the Rock Island, the Milwaukee & St. Paul, and the Northwestern; and with these ample connections the Union Pacific is better off than it would be if it had to enter the competition for traffic between Chicago and Missouri river points with its present friends, and fix the rates for its whole system by the competition there.

THE ILLINOIS CENTRAL.

This company's lines form a Southern as well as a Northwestern system. The Southern lines were shown and described in ENGINEERING NEWS of Feb. 2, 1889. The total mileage of the system is 2,743 miles, of which 863 miles are located south of the Ohio river. The original main line extends from Chicago to New Orleans. The main line of the Northwestern system extends from Chicago west to Sioux City, Ia., 491 miles from Chicago. Branches terminate at Sioux Falls, Dak., Onawa, Mona., and Cedar Rapids, Ia., and Madison and Dodgeville, Wis. There is a considerable system of minor branches in the district between Chicago and Springfield, Ill.

The growth of the system has been less rapid than that of the systems already considered, yet in 1879 the company operated 1,255 miles of lines, and it has, therefore, rather more than doubled its mileage within the past decade and won at the same time a reputation for conservatism. The probable future extensions of the system were outlined in a recent editorial (ENGINEERING NEWS, March 16, 1889), the most important of which are the proposed lines in Wisconsin and the Pacific Short Line scheme in Nebraska. The annual report states that "the directors of the company have no new extensions in view," and as this was clinched by a vote at the stockholders' meeting, it may be safely concluded that no new work will be undertaken directly for some time to come. A very important piece of work to be finished in November is a new Ohio River bridge at Cairo. Its total cost will be about $900,000.

The company held its own last year better than most of the Northwestern systems, making gross earnings of $11,868,036, and net earnings of $4,067,871, which, however, was less by about a million dollars than the profits for 1887. The company's financial record is of the very best. Since 1863 the total amount of cash dividends paid to its stockholders is $56,989,848.

The four systems forming the third group upon our map are of much less extent than the great systems forming the first two groups. They are the Wisconsin Central and Minneapolis, St. Paul & Sault Ste. Marie, lying chiefly in Wisconsin, and the Chicago St. Paul, & Kansas City and the Burlington, Cedar Rapids & Northern, lying chiefly in Iowa.

THE CHICAGO, ST. PAUL & KANSAS CITY.

This is one of the youngest of Northwestern systems, yet it now has an extent of 1,349 miles. The system is appropriately called "the Diagonal," as from the four chief terminals—Chicago, Peoria, St. Joseph and St. Paul—lines converge to a junction in Central Iowa. The system is a consolidation of the Minnesota & Northwestern, the Wisconsin, Iowa & Nebraska, the Dubuque & Northwestern, and other railways, formed about one year ago. Almost all the lines at present operated by the Chicago, St. Paul & Kansas City have been built within the past 5 years. The Central Iowa lines extend from Peoria, Ill., across the Mississippi at Keithsburg to a point in northern Iowa. Several branches ramify in the Iowa coal fields. The Central Iowa has been in the hands of a receiver since 1886, but is being reorganized to form a part of the Chicago, St. Paul & Kansas City system.

The Chicago and St. Paul line of the company is as short as that of any of its competitors, but as its grades are less favorable than those of the lines along the Mississippi river it is somewhat hampered in its competition for through freight traffic. As a through north and south line, the company's road from St. Joseph to St. Paul ought to do a good business, especially when it is extended to Kansas City. As our map plainly shows, there is no other direct line under one management reaching from St. Paul to Kansas City. An extension from St. Paul to Lake Superior was located two years ago, and arrangements were made for terminal facilities at West Superior; but its construc-

tion was wisely postponed to a more propitious season.

THE WISCONSIN CENTRAL.

This system lies almost wholly in the State of Wisconsin. It consists of a main line from Chicago to St. Paul, with a branch north to Ashland, and another south to Portage City, a total extent of 743 miles. The Chicago and St. Paul line is 462 miles in length, about 50 miles more than the Chicago, Milwaukee & St. Paul route. The changes of name and corporate management of the railways composing the system have been very numerous. The first lines of the system were built between 1871 and 1877. The extensions to St. Paul and Chicago were built in 1884 and 1886. The present corporation, under which the various lines of the system are united, was formed two years ago. The alliance which the company has just made with the Northern Pacific company will tend to make the system of less prominence except in connection with its ally. The financial prosperity of the railways composing the system has never been overwhelming. Under the present organization, however, and with the backing of the Northern Pacific, its future prospects seem very favorable.

THE BURLINGTON, CEDAR RAPIDS & NORTHERN.

This system has an extent of 1,046 miles, almost all of which is located in Iowa. The main line extends from Burlington northwest to Watertown, Dak., 500 miles, with a branch to Albert Lea, where connection is made with the Minneapolis & St. Louis. Other branches run to Sioux Falls, Dak., and to various local points in Iowa. As the system has no line of its own to Chicago, it depends on the Rock Island and the Burlington lines for an outlet in that direction. But its route from the principal points reached in Dakota and Iowa is then less direct than that of its competitors; neither is the system advantageously located for turning its traffic toward the new outlet for the Northwest via Lake Superior, for the general trend of the lines of the system is northwest and southwest. Relying thus largely on its local traffic, the road has felt very seriously the effect of the reduced rates established by the Iowa State Commission; as much so, perhaps, as any of the railways in that State.

The first line of the system was built in 1870, from Burlington to Cedar Falls, Ia., 163 miles. Most of the lines in Iowa were built between that time and 1880. The Dakota extensions have been built since that time. It is not known that any extensions of importance are planned. Indeed, it is difficult to see how any extensions can greatly increase the present value of the system. The original line was planned and built as many other local lines have been built, to help the commerce of a single city (Burlington) as well as to earn dividends for its stockholders. And like almost all lines planned with this end in view, as it was planned to secure local development, it must be content for the most part with a local traffic.

THE MINNEAPOLIS, ST. PAUL & SAULT STE MARIE

This system consists of a single main line extending from Boynton, Dak., via Minneapolis and St. Paul, to Sault Ste. Marie, Mich., 782 miles. The first portion of this line completed was a 46-mile stretch east from Turtle Lake, Wis., opened for traffic in 1884. The main portions of the line were built in 1886 and 1887. The road was planned by some of the wealthy millers of Minneapolis, who wished to secure an outlet for their enormous flour shipments, and for the fast growing traffic between the cities of St. Paul and Minneapolis and the East independent of the Chicago systems, and avoiding the delays and expense in transfers at that point. They secured the alliance of the Canadian Pacific managers, who agreed to extend their abandoned branch then terminating at Algoma Mills, Ont., to Sault Ste. Marie, and to join in the work of erecting a bridge at that point. The line from Minneapolis northwest was built as the Minneapolis & Pacific railway. It draws traffic from a fertile area of the Minnesota and Dakota wheat fields, and is eventually to be extended to Bismack, Dak., the extension being already partly graded. Since the road was completed, parties closely identified with the interests of the Canadian Pacific have purchased large blocks of stock of the company, and it is now admitted that the road is practically controlled in the Canadian Pacific interest. By the construction of this road, the cities of St. Paul and Minneapolis have placed themselves on at least an equal footing with Chicago as a collecting center for a large part of the Northwest. There seems little prospect that this "Canadian competition" will ever be cut off; and the "Sault route" as a competitor of the Chicago systems and the trunk lines, has evidently come to stay.

The minor systems and local lines of the Northwest, we will discuss in the following issue.

American Railways vs. Canadian.

The proceedings of the United States Senate Committee on Interstate Commerce, which has been holding a session in this city to investigate the charge that Canadian railways are diverting traffic from American transportation lines, have been of especial interest from the prominence of the witnesses who have been examined by the Committee, and the opinions they have given on various matters connected with the railway problem. They seem to demand a full abstract.

At the opening session on Monday, May 6, the first witness called before the Committee was ALBERT FINK, Chairman of the Trunk Lines Association. He stated the object of the Association to be the establishment and maintenance of rates, subject to the Interstate Commerce law. Except that there was no division of traffic, the Association was carried on just as before the passage of the law. The Grand Trunk and some American roads were given a differential on through traffic to compensate for their disadvantages. He did not regard this as in any sense a discrimination. Differentials were necessary to enable the less direct routes to secure any business. In regard to export business, he believes that the law could not be enforced. The Grand Trunk was obliged to subsidize the steamer lines, which it connected with at Portland, to induce them to run there. Railways terminating at Norfolk, Newport News and Philadelphia had to take similar action. The Grand Trunk carried about 20 per cent. of the west-bound through traffic over the trunk lines. If no differentials were paid the Grand Trunk, it would be shut out of the country. He did not think this would have any effect on freight rates. It was convenient to have the Grand Trunk, but if that and a half dozen other roads did not exist, it would be of no consequence to shippers. There were too many railroads. Of course, if the Grand Trunk were banished, certain sections would have less favorable facilities than now. More than New England would suffer. He did not think Canadian transportation could be controlled by American legislation. In case of a rate war, American lines would suffer more than the Grand Trunk, for that could recoup on Canadian local traffic, not being bound by the long and short haul clause as are American roads. He suggested that the Interstate Commission be given the right to permit American roads to so arrange rates that they could compete with Canadian roads. Matters might also be remedied if the anti-pooling clause were repealed.

The poorer a railroad is, the more dangerous it is as a competitor. The cost of a road and its operating expenses have little effect in determining rates. He did not care to say that the millennium would come when the Government secured control; but matters seemed to be tending in that direction. A power was wanted that could arrange rates and enforce them. Managers would be willing to give up control if the Government would secure payment of bonds and stock.

The difference between pooling and the Interstate law is that the latter proposes punishment for secret rate-cutting while pooling divides the business without compelling each road to fight for its share. Unfortunately the law provides no means for its own enforcement. The idea of five men, in the face of all their other work, enforcing the law on 150,000 miles of railroad was nonsensical. The law had done much good, but the commission could not enforce it, for it was buried under work. The prohibition of pooling had done more harm than the rest of the law had done good.

The second witness was JOHN KING, president of the New York, Lake Erie & Western Company. He said that the Grand Trunk was both an important competitor and an important connection of the Erie. The Erie receives a differential on west-bound freight, but is a million dollars short on competitive business compared with what it would have been under the pooling system. The effect of the Interstate law has been to strengthen the strong roads and injure the weak ones. The differentials ought to be increased. Since the amendment passed, the law has been pretty strictly observed. The Canadian roads have an opportunity to evade the law that American roads do not have. The shipper in Chicago may get a rate for Liverpool and a draft may be sent to Liverpool. It is difficult to put a finger on the offender, between the shipper, the railway, and the steamship company. The Erie gets a small proportion of Chicago business, not nearly so much as the Grand Trunk. Our impression is that they give drawbacks. That is the only way we can account for the fact that a few weeks ago they got 39 per cent. of the business, whereas they had been getting but 20 per cent. We do not ask for any advantage; but the Interstate law should apply to Canadian roads that enter American territory. The pooling system is not a panacea; but it ought to have been replaced by a better system. Under the Interstate law some roads cannot earn their fixed charges. Our receipts are less and we have had to spend more in putting the road in good condition. I do not think a railroad man in the United States wants to see the Grand Trunk shut out. Our through competitive business is small, after all, compared with other kinds of business. We make more money from the 10,000,000 tons of coal we carry than from all the through business.

At the second day's session the first witness was Mr. CHAUNCEY M. DEPEW, president of the New York Central System. He said Canadian roads were not bound as American roads were by the Interstate law. He understood that there was a contract between the Grand Trunk and the steamers that ran to Portland which was unfair to American roads Only in this way could be account for the large increase in the Grand Trunk's business. He thought, however, that the Grand Trunk officials tried to live up to the law, though they could easily evade its provisions if they chose.

Railroad business differed from all other kinds. Competition could not wipe out a road. Differentials enabled the weaker roads to live, and gave the country stable rates. Conditions had improved since the passage of the Interstate law, but it would have been far better if pooling had not been prohibited. In another way the law did not go far enough. It did not prevent speculators and investors from building roads for which there was no necessity.

It seemed monstrous for the Government to tie up our roads and not use the same methods toward Canadian roads. If the matter was left for the American roads to settle, they could lay out the Canadian roads in a short time. The powers of the Interstate Commission should be enlarged so that it could oblige any Canadian road which wished to do business in the United States to conform in every respect to the law.

What the public most needed was stable and honest rates, for unstable rates ruined business. These could be obtained by a legally organized pool. The weakness of the pool always was that it could not enforce its agreements. The Government could provide against any attempt to make exorbitant

rates. The pool and the Government could agree upon rates, and the latter could enforce them.

The next witness was JOSEPH HICKSON, General Manager of the Grand Trunk Railway. He said that the company under his management controlled nearly a thousand miles of railway lines in the United States. The Canadian Government loaned £3,000,000 to the Grand Trunk when it was built, and are part owners to that extent at present. The Grand Trunk was a member of the Trunk Lines Association, observed their agreements, and charged the established rates. It was allowed a differential of 5 cts. per 100 lbs. on dressed beef from Chicago east, and also a differential on west bound business from New England.

In reference to the Interstate Commerce law he said:

We consider all our business done in the United States or carried through Canada from State to State, under the provisions of the Interstate law. We publish our rates and abide by them. We observe the long and short haul clause on American business, but on local traffic in Canada we are of course not under control of the Interstate Commission. If freight is carried from Detroit to Montreal, or from Detroit to Portland, it is carried under the provisions of the Interstate law. It is only on purely local Canadian business that the law is not considered. In that respect we are in the same position as the American roads in relation to the Interstate Commission.

Referring to the recent trouble about coal freights, he said, "We were advised by counsel that we might make a special rate to large shippers." The company has submitted its published tariffs to the Commission since the case was decided. Local rates in Canada were as low as in the United States. The Grand Trunk did not recoup in Canadian territory for losses sustained on the American side. Rates were not specially revised at the passage of the Interstate law. The Grand Trunk fostered its traffic by a line of first-class steamships to Portland. Through rates to Liverpool were made at Chicago, according to Atlantic competition. Rates via Portland were a little less than via New York. No rates were paid on through export freight since the passage of the Interstate law. The recent increase in the Grand Trunk's east-bound traffic was due to natural causes. The company had fine facilities, especially for the shipment of grain. The increase was not due to differentials or rebates or subsidies to steamships. The company did not subsidize steamships or buy space in them. It contracted to give the Allan Line of steamers fair loads, for if this was not done the steamers would not run to Portland. There was no official or corporate relation between the steamship company and the Grand Trunk.

Suppose it were required that the company transact all its business according to the provisions of the Interstate law, was asked. That was an international question beyond the province of any railway company to answer. The company could be summoned to Washington and compelled to show its books. It was willing to do so and would gladly furnish all information about its local traffic Except for the difference in the price of coal, the running expenses of Canadian roads were about the same as those of American lines. The receipts of American lines for carrying Canadian traffic are greater than those of Canadian roads for carrying American traffic. The new short line of the Canadian Pacific to the sea-board was described. Mr. HICKSON thought it possible that some of the traffic now carried by the Grand Trunk might be diverted to this route. He promised to furnish the Committee with full statistics of the operation of the Grand Trunk.

Mr. S. M. FELTON, First Vice President of the New York, Lake Erie & Western, said that his road lost money under the operation of the Interstate law because it had interpreted it more rigidly than its competitors, who did not observe its provisions, while the Erie did. Several people in the room smiled. He believed Mr. HICKSON had stated the Grand Trunk's position very fairly. The Canadian Pacific, he thought, could manipulate business so that neither American railroad men nor the Interstate Commission could discover how it gained the traffic. The Erie got no flour business from the Northwest now. It went via the Sault and Canadian Pacific lines. He did not consider this a natural route for such business.

On Wednesday the first witness called was CHAS. FRANCIS ADAMS, President of the Union Pacific Railway. He described the system under his control. There were few points where the company did not meet with competition. It was active at every point east of Cheyenne and Denver. The first competitor for Pacific Coast business was the Southern Pacific. Then the Atchison followed suit, and then the Denver & Rio Grande.

Regarding the Interstate Commerce law, it has never been sufficiently enforced to test its actual results.

The impression left on my mind regarding the result of the act is that the line offering the least resistance to commerce will not get its natural business. The tendency of the act is to divert traffic from its natural channels. The effect of the act is to put East and West lines at a disadvantage in comparison with the Canadian lines of railway and steamships. The act does not affect us except on transcontinental business, and I do not think any human law can long stand in the way of natural business. There is a great deal of truth in Gen. GRANT's aphorism that the best way to deal with a bad law is to enforce it. The Interstate act has not been enforced. In some respects it is good; in others poor. It was not framed on practical experience, but on *à priori* principles. The commission is a complicated bit of machinery, but it has made surprising advance, and I am advised the companies are now obeying the law.

In answer to Senator CULLOM, he said that any company which had honestly lived up to the law for two years would have found itself in a lamentable condition.

Referring to the transcontinental traffic, he said the Canadian Pacific had probably taken some business from the other Pacific coast lines, like every other new competitor; but the road was still a new line, and the final result of its competition could not be foretold. If the Union Pacific had a fair chance, it could take care of itself notwithstanding the Canadian Pacific competition. The Union Pacific is the natural route. It is among the Pacific roads what the New York Central is among the trunk lines.

"In January, orders were given to observe the Interstate law rigidly at all points on the Union Pacific system. Business at once flattened out; but it may have been due to local causes. The condition of the Northern Pacific alone is satisfactory at present, and I not sure this is not due to local causes. The present status of affairs cannot last much longer without bringing disaster. I am not an enthusiastic believer in pooling, but perhaps it ought to be legalized."

In reply to Senator CULLOM'S request for suggestions as to amendments to the Interstate law, he replied:

I want to see the law as it is enforced. The railroad business was built up on a different system. It is undoubtedly best to stop cheating. Rebates should be abolished. I think to-day matters are working very well. The commission is doing well. I am in favor of letting the law stand until the commission discovers where it can be changed to advantage. My position to day is the same as it was when I was on a railroad commission. Publicity will remedy many existing evils and time will probably do the rest. . . . We were all alarmed before the railroad presidents met in this city. One thoughtful Western man said to me that if we were approaching a chasm steadily, we must in time go over it. Demoralization seemed to foreshadow disaster. That meeting had its effect for good. The meetings and investigations of the Interstate Commission are strong factors for good. They have a most complicated piece of work to perform, and they are proceeding wisely.

Mr. ADAMS did not wish to express an opinion regarding the advisability of shutting out Canadian roads or putting them under the same restriction as American lines. He was opposed to the long and short haul clause of the Interstate law, and thought also that the large shippers should receive more favorable rates than small shippers.

If the railroad business of the last four months indicated future conditions, it meant disaster; but he considered the railroad business to be under the painful conditions of readjustment, and until the new order of things was given a fair chance to develop he was in favor of the enforcement of the law as it stood.

The next witness, JAS. J. HILL, President of the St. Paul, Minneapolis & Manitoba, was questioned chiefly concerning the Canadian Pacific, of which he was one of the first projectors. He denied the report that his system was to become closely connected with the Canadian Pacific, but stated that the "Sault" and Duluth, South Shore & Atlantic systems, running from the Sault Ste. Marie to Duluth, St. Paul, and central Dakota, were supposed to be under Canadian Pacific control. In a short time the Canadian Pacific managers intended to have a fast ocean service between England and Halifax and carry passengers from England to St. Paul as quickly as they are now carried from England to New York. He thought it would be possible to go to Yokohama from New York in two weeks' time, within 18 months from now. It would be a difficult matter for Congress to control the Canadian Pacific as it was entirely on Canadian soil. The line through Maine was an American line, and to prevent its building would make no material difference in the fast time the company expected to make.

Mr. HILL expressed his belief that the Government should regulate the construction of railways. He also said that the Government had appropriated enough for improving the Mississippi river navigation to have built a railroad on its banks able to carry all freight at less than the river rate.

ERASTUS WIMAN, the prominent advocate of commercial union, was closely questioned by the Committee. He said that to shut out Canadian roads would be a serious thing, not only for them but for the East and the Northwest. He considered it hard, however, that American roads should be governed by a law that did not touch Canadian roads. Commercial union would obviate all obstacles now in sight.

On Thursday morning GEO. B. ROBERTS, President of the Pennsylvania Railroad system, was the first witness called. He believed the fact that Canadian lines were not under the same restriction as American gave the former an advantage. The Pennsylvania has not greatly suffered, but it has felt the effect of the independence of the Grand Trunk. Canadian roads may observe the Interstate law in the United States; I do not know. I don't know that Canadian roads do serious injury to roads in the United States, but they have an advantage, which they can improve if they choose. As far as economy in moving traffic is concerned, the Pennsylvania can operate between Chicago and the East as cheaply as any other road. The difficulty is that American roads must compete in a sense with the Government of Canada.

The Trunk Line Association benefits both the public and the railroads. It provides for stability and uniformity of rates. Whatever is for the benefit of the public is for the advantage of the railroads. There has been improvement since the enactment of the Interstate law. It has tended to increase the honesty of the administration of railroads. I think railroad men generally are head and shoulders above those engaged in most vocations. The conditions that prevailed before the law's enactment were not the fault of the railroads. They had been under no sort of supervision. Such a law should have been passed years ago. It was full time that the Government should exercise some sort of control. If Canadian roads are not willing to abide by the law, they should be shut out from American business. It would be largely to the advantage of both countries, however, to have the present commercial barriers between them wholly removed.

W. C. VAN HORNE, President of the Canadian Pacific system, gave a brief description of the system under his management. The Minneapolis, St. Paul & Sault Ste. Marie and the Duluth, South Shore & Atlantic were not controlled by the Canadian Pacific, but the parties who controlled them were friends of the Canadian Pacific. Ninety per cent. of the Canadian Pacific traffic was of Canadian origin. This included cotton goods business from Canada to China. Very little purely American business passed the Detroit frontier. American roads competed for traffic between Ontario and Manitoba. The Canadian Pacific got a differential on Pacific coast business. He gave a brief history of the company, and stated that the company received from the Government 714 miles of completed road, costing $35,000,000. This was not worth to the company more than $10,000,000. The company also received $35,000,000 and 18,000,000 acres of land. It got 10 or 12 per cent. of the transcontinental traffic, and enough of a tea trade to keep a line of steamers running from Vancouver to Yokohama and Hong Kong. The imperial government is to furnish a subsidy of £60,000 per annum for a fast line between these points. They are to be fitted to act as war cruisers if needed, and will be able to make 17½ knots. We hope to be able to take passengers from London to

Yokohama in 21 or 22 days. The time now through the Suez canal is 38 or 39 days. Across the Continent the time is now about 28 or 30 days—six days for the Atlantic ocean, six days for across the Continent, and sixteen days for the trip from Vancouver to Yokohama.

There was little difference in the rates of through and local freights. The company conformed to the Interstate law whether the goods were carried from an American to a Canadian point or from a Canadian to an American point. Every agent was under instruction to obey the law. Rates are published, and while the company did not voluntarily observe the long and short haul clause at first, counsel decided that according to the law it was bound to do so.

The American lines were not the chief competitors for Asiatic trade. The principal competitor was the Suez canal. The Canadian Pacific did not expect to compete with this route in through freight traffic, but it could on through passenger traffic.

There was not a day in the year when the Canadian Pacific could not be operated. Its snowsheds were really cedar tunnels. They cost as much as $300,000 a mile.

Mr. JOHN NEWELL, President and General Manager of the Lake Shore & Michigan Southern, and HENRY B. LEDYARD, President of the Michigan Central, both testified to the effect that the Grand Trunk was a sharp and successful competitor to their respective lines. They were of the opinion that, on export business especially, the Grand Trunk was in some way or other making better terms to shippers than those fixed by the Trunk Lines Association.

Senator BLAIR asked if Canada ought not to give Americans the benefit of a general railroad law such as the United States gave Canadians. Mr. NEWELL said he would not object to the abrogation of the general railroad law. Senator BLAIR said that was generally the way with people who had got all they wanted.

Mr. LEDYARD wanted the United States to enact a law by which it could make the freight and passenger rates for Canada. Senator BLAIR hinted that it might be difficult for the United States to do in Canada what it was not able to do in its own territory. Did Mr. LEDYARD want a new law, one that would make rates as well as enforce them? Mr. LEDYARD said he did.

To Senator GORMAN Mr. LEDYARD said a half cent per ton per mile for freight would not pay 4 per cent. on the capital invested.

On the last day of the session the first witness who appeared was CHAS. S. SMITH, president of the New York Chamber of Commerce. He said for that body that the Interstate Commerce law was believed to be an act of great public service and to have resulted in important benefit to the people, although it could be amended and revised to advantage. He recommended the repeal of the long and short haul clause and the clause prohibiting pooling; but he thought the legalized pool should be subject to supervision by the Interstate Commerce Commission. He thought the law was not yet obeyed even half-way.

The Canadian lines have been of great advantage to New York, and to the extreme East and West. It was unfair to American roads to permit Canadian lines to carry business from American points to Canadian points unless they submitted to the same restrictions. Canadian roads are getting a much larger percentage of the traffic than formerly.

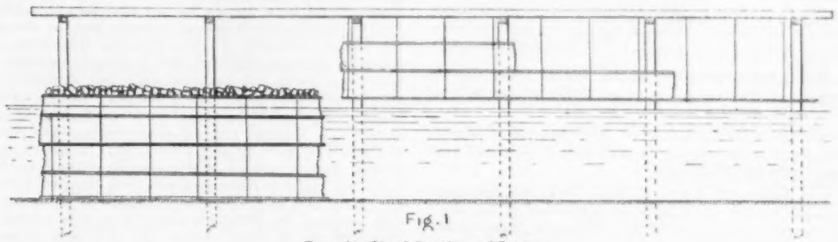
The New York Produce Exchange was represented by J. H. HERRICK, who commended heartily the work of the Interstate law and objected to any repeal of the long and short haul and pooling clauses. The most obnoxious practice of the railways at present, in his opinion, was the making of through export rates less than the seaboard rates. WM. H. AMMIDOWN indorsed Mr. SMITH'S statements, but wished all obstacles to competition removed, so that freights might be reduced to the lowest possible figure. He was opposed to pooling, except under such restrictions as would prevent it from interfering with competition, but confessed that he did not know what sort of restrictions could accomplish that impossible task.

JOHN D. KERNAN, ex-railroad commissioner of New York, also opposed the repeal of the pooling and long and short haul clauses. The Canadian roads doing American business should be placed under the laws governing American roads.

The committee then adjourned to meet in Boston on July 5.

Jetties for Brazos River Improvement.

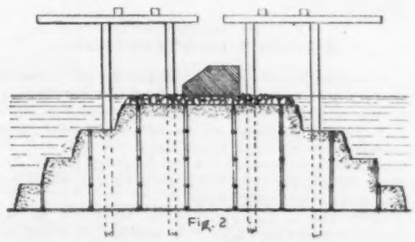
In designing jetties for the above named works, great stability, with least weight, a minimum of loss of water from leakage and absolute safety from action of the teredo have been considered essential.



Longitudinal Section of Jetty.

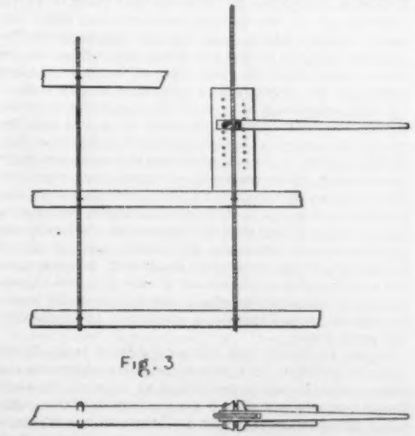
The accompanying cuts show how these ends were secured.

The usual method of sinking mattresses by loading with stone, besides being very expensive, does not fill the stated requirements. It is impossible to distribute the stone evenly over the surface of a mattress under water, and the consequence is that the next mat above rests on the tops of the heaps of stone, leaving cavities in the jetty and channels for escape of large quantities of water; the



Cross-Section of Completed Jetty.

teredo also has an excellent chance to get in his destructive work, which may, as in the case of the Galveston jetty, cause a shrinkage of 60 to 70 per cent. in volume. To avoid these objectionable features of mattress work, it has been deemed advisable to place the necessary weight for sinking the



Mattress Strip, Binders and Jack, Brazos Harbor.

mats in the mattresses themselves and of such materials as to diminish leakage and check the action of the teredo.

This is accomplished at Brazos in the way outlined in the cuts, by filling the interstices of the brush with shell and clay before applying compression strain on the binders connecting the mattress strips. Mattresses thus loaded must necessarily be built in place. This is accomplished by suspending the lower mattress strips from trestle work, and as the mattresses are built up, lowering the entire mattress until a solid, homogeneous jetty is complete from bottom of gulf to height required.

Compression strains are applied to the binders equivalent to about 100 lbs. to each square foot of mat, thus giving the structure a solidity much greater than can possibly be obtained by the usual method of loading.

In the accompanying engravings, Fig. 1 shows a longitudinal section of jetty and method of construction, as described above. Fig. 2 shows a cross section of the completed jetty after being consolidated by loading with rip-rap and concrete sea wall. Fig. 3 shows details of mattress strips, binders and jack for compressing the mats. With this brief explanation, the drawings will tell their own story.

The works on the Brazos river are being carried on, not by the Government, but by the Brazos River Channel & Dock Co., of which Mr. E. L. CORTHELL is chief engineer, and Mr. GEO. Y. WISNER resident engineer, at Velasco, Brazoria county, Tex. By the method used they are able, as noted, to build a continuous jetty, homogeneous from bottom to top, for about two-thirds of the cost by the older methods of construction, and at the same time obtain much more stable work. It is a well-established fact that the teredo will not trouble the brush of mattress work after it becomes saturated with sediment; and by adding clay with the shell filling, they may be said to simply assist nature in protecting the works. However, there would be but little danger from the teredo on this work in any case, as at high stages the Brazos river carries nearly double the amount of sediment per cubic foot of water that the Mississippi river does.

In our issue of April 13, we gave the width between jetties on this work as 460 ft. This was incorrect. The clear width is to be 560 ft. The channel of river above the jetties will, however, be rectified to a uniform width of about 450 ft. Mr. WILKE, the contractor, is pushing the work as rapidly as possible, and the probabilities are that inside of twelve months he will secure 24 ft. of water from deep water in river across the bar.

His contract is for only 20 ft., but with a current 50 per cent. stronger than that at the South Pass, there is thought to be little doubt that the central depth through the jetties will be at least 25 ft.

We are indebted for all the details of this article to Mr. GEO. Y. WISNER, resident engineer.

THE DRIGGS RAPID FIRE-GUN was tested at Annapolis last week by U. S. naval authorities. Nineteen shots were fired in one minute and 60 rounds in four minutes and twenty seconds. The weight of the shot is six pounds and the ammunition is fixed. Lieut. DRIGGS, U. S. N., the inventor, was present.

PERSONAL.

Mr. JOHN H. COOK has been appointed Water Commissioner of Red Bank, N. J.

Mr. P. CALHOUN has been elected President of the Richmond & West Point Terminal Ry. Co., vice Mr. JOHN H. INMAN, resigned.

Mr. JOHN J. HENRY has been appointed Master Mechanic of the Cleveland, Akron & Columbus.

Mr. H. T. PEYTON, for 13 years Master Mechanic of the Missouri Pacific road at Hannibal, has resigned, and is succeeded by Mr. JOHN CAMPBELL, of Parsons, Kan.

Mr. H. H. MANSFIELD, dealer in railroad and contractors supplies, 36 Pine St., N. Y., has been appointed agent in that city and vicinity by the Frankford Steel Co. of Philadelphia. He also represents the Whitney Car Wheel Works, of Philadelphia.

Mr. COLIN R. WISE, of the firm of Wise & Watson, Civil Engineers and Surveyors, who have charge of the construction of the new sewer system of Passaic, N. J., has been appointed City Surveyor of that city.

Mr. C. D. WILLIAMS, Superintendent, has been appointed Auditor of the Alleghany & Kinzua, with headquarters at Bradford, Pa., vice Mr. J. E. ROONEY, who remains Treasurer, with office at Olean, N. Y.

Mr. GEO. T. JARVIS, Superintendent of the Duluth, South Shore & Atlantic, has covered his connection with the road. His duties will devolve upon General Manager FITCH.

Mr. A. D. SAVAGE, of Indianapolis, has been appointed Superintendent of Construction of the Milwaukee, Lake Shore & Western Railroad Co.'s 90-mile extension west from Ashland, Wis.

Mr. C. E. SOULE has been appointed Superintendent of the Quincy, Omaha & Kansas City Railway, with office at Quincy, to succeed Mr. F. D. SCHEMERHORN.

Mr. LEONARD H. PERKINS, for 16 years Roadmaster of the Air Line Railroad, died suddenly in New Haven, Conn., May 5, of heart disease.

Mr. B. D. MCCONNELL has been appointed Superintendent of the Water Department at Montreal, vice Mr. LOUIS LESAGE, deceased

Mr. HERBERT VAIL, of New York, has been appointed Chief of the Construction Division of the office of the Supervising Architect, Treasury Department, Washington, D. C.

Mr. GEORGE GOULD has been elected a Director of the St. Louis, Arkansas & Texas Ry. Co., vice Mr. J. M. WELLS, resigned.

Mr. JOHN P. KELLY, civil engineer on the eastern division of the New York State canals, was married recently to Miss A. M. SHEEHAN.

Mr. PAUL S. KING has been appointed chief engineer of the Buffalo & Geneva Railroad, with headquarters at Buffalo, N. Y.

Mr. RUSSELL WIGHT, formerly Commissioner of Public Works of Long Island City, N. Y., died in Brooklyn, N. Y., May 5.

Mr. A. RAPP, formerly with the Pullman Car Co., has been appointed Assistant Superintendent of the St. Charles Car Co., at St. Charles, Mo.

Mr. JAS. A. O'NEIL, water-works contractor, formerly of Fredonia, Kan., is now located at 25 Fletcher Ave., Indianapolis, Ind.

Mr. C. W. BOOTH having resigned the position of General Freight and Passenger Agent of the Texas, Sabine Valley & Northwestern Ry., his duties will be assumed by Mr. RICHARD J. EVANS, General Manager Longview, Tex.

Mr. M. S. PARKER has resigned his position as Chief Engineer of the Sioux Falls, De Smet & Northern Ry. He located about 500 miles of the Montana extension of the St. Paul, Minneapolis & Manitoba Railway in 1886, 1887.

Mr. LUCIUS TUTTLE has been appointed Commissioner of the Passenger Department of the Trunk Lines Association, with office at 346 Broadway, New York. He was until recently Passenger Traffic Manager of the Canadian Pacific.

Mr. W. S. WILSON, Roadmaster on the Union Pacific, has resigned to go on the Denver & Rio Grande, at Denver, Col., and has been succeeded by Mr. M. RYAN, from the main line, whose headquarters will be at Beatrice, Neb.

Mr. BENJAMIN RYALL has been appointed Manager of the Port Jervis, Monticello & New York Railway, and Mr. ELI MCMILLAN has been appointed Superintendent. Mr. RYALL is Superintendent of Public Works at Saratoga Springs, N. Y.

Mr. JOHN S. WILSON, President of the Poughkeepsie Bridge and adjunct railway companies, has removed his office from Poughkeepsie to New York. He has appointed Mr. S. B. ODYKE, formerly of the Pennsylvania Railroad, Superintendent of all the lines; Mr. D. P. MARTIN, Superintendent of the Connecticut Division, and Mr. GEORGE C. THAYER, recently of the Pennsylvania Railroad, Superintendent of the Western Division.

Mr. WM. WESTON, Chief Assistant to Col. W. E. MERRILL, U. S. Engineer office, Cincinnati, O., died of yellow fever at Manoas, Brazil, March 27. Mr. WESTON had been in the United States service for 20 years, and for years was in command of the Upper Mississippi, where he superintended the construction of Rock Island bridge. In the summer he spent his time at work for the Government, but in winter he traveled as a newspaper correspondent.

Gen. E. M. BIDDLE, Secretary and Treasurer of the Cumberland Valley Railroad Company, died in Carlisle, Pa., on May 13. He was born in Philadelphia on July 27, 1808, and was graduated at Princeton College in 1827. In 1839 he was elected secretary and the following year treasurer of the Cumberland Valley Railroad Company, which office he held until his death. He was appointed Adjutant-General of Pennsylvania by Gov. CURTIN in 1861. He was one of the oldest railroad officials in the United States.

Gen. ADNA ANDERSON, one of the best-known railway engineers in America, committed suicide, while temporarily insane, in his room in the Lafayette Hotel in Philadelphia on May 14. Gen. ANDERSON was born in Ridgeway, Orleans county, N. Y., July 25, 1807. About 1847 he entered the service of the New York & New Haven Railroad as a chainman and was soon an assistant engineer on the Connecticut River Railroad. In 1849 he went South, and was successively engaged as an engineer with the Mobile & Ohio, the Ashuelot, the Tennessee & Alabama, the Edgefield & Kentucky, and Henderson & Nashville railways, having in this time also been resident engineer on the Michigan Southern and the Northern Illinois railways. He was with the Henderson & Nashville Railroad when the civil war broke out, and at once came North and was appointed chief of construction corps of the Army of the Potomac. In February, 1863, he was commissioned chief engineer of the military railways in Virginia and did some phenomenally rapid and effective work in this connection. In 1864 he was general superintendent of government railways in the military division of Mississippi, and from November 1864, until July, 1866, he acted as chief engineer of all the military railways. In 1867 he was for a few months chief engineer of the St. Louis bridge, and was then general superintendent of the Kansas Pacific Railroad and later general manager and vice-president of the Toledo, Wabash & Western Railroad. In 1873 Gen. ANDERSON was president of the Lafayette & Bloomington Railroad; in 1875 he was receiver of the Chicago, Danville & Vincennes Railroad; and in February, 1880, he was appointed chief engineer of the Northern Pacific Railroad, and was elected second vice-president of the same road in October, 1886. He held both of these positions until January, 1889, under a salary of $15,000 per annum. At the time of his death he was engaged in organizing the Gordon Fire Alarm Company and the Steel Car Company. He leaves a widow and four children at his late home near Sing Sing, N. Y.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The regular meeting was held May 15, Past-President WORTHEN in the chair. The Secretary announced the death of Major A. P. ROGERS, on May 1; he was one of the most noted railway locating engineers in the Northwest, and did considerable exploration for the Canadian Pacific Ry., being the discoverer of the Roger's Pass, by which that road crosses the Selkirk range.

There was a very interesting discussion on Mr. RAFTER'S paper on "Algæ," an abstract of which was published in ENGINEERING NEWS, May 11. The subject will be further discussed at the annual convention, in June, when Mr. WORTHEN will present a paper. One speaker suggested that if the Quaker Bridge dam is built, and the site of the reservoir is not thoroughly cleared, there will be considerable trouble from algæ and bad condition of the water, as was the case at New Britain, Conn. Mr. FTELEY, in the course of a most interesting discussion, stated that the reservoir would only be a great enlargement of the present comparatively small and shallow Croton lake, and as this lake furnishes water of excellent quality; he did not think any serious trouble would result from the great body of water in the new reservoir. Mr. FTELEY then proceeded to give some of his own experience with algæ in connection with the Boston new water-supply, of which he was so long the executive engineer. He concluded by remarking that, in his opinion, hydraulic engineers and scientists really knew so little of the real cause of trouble from algæ, and of the laws controling its erratic appearances in a water supply, that it would be proper and profitable for cities to combine their money with the observation and experience of engineers and scientists, and to thus make possible a systematic, widely extended method of investigation, and a comparison of results and all the elements of location, time, temperature, effects and remedies. He hoped the Society would appoint a committee to inaugurate this good work.

Mr. BRUSH stated that in his experience in supplying water to Hoboken, N. J., and several other towns on the same system, he had found it best to keep the water in circulation, and not store it for any length of time. He used a small storage tank at each town, but at Hackensack, where there was a large reservoir, a good deal of trouble was caused by vegetable growth. This trouble he avoided by sending the supply through the by-pass, using the reservoir only in case of emergency for fires, etc.

Prof. LEEDS had suggested aerating the water supply, and good results had been obtained, while at the Hackensack reservoir little trouble had been experienced since the aerating system had been in use. He suggested, as remedies for trouble with vegetable growth, that the water be kept in circulation, that the reservoir be treated as an aquarium and a proper balance maintained between animal and vegetable life, and that the water be aerated. Prof. LEEDS stated that he did not think the extent of our knowledge on this subject to be so limited as Mr. FTELEY had said. He referred to filter processes, and stated that he had suggested aerating the water supply at Philadelphia several years ago, and this was finally carried out by Col. LUDLOW, the engineer of the water department of that city.

American Society of Civil Engineers.—Annual Convention of 1889. The Convention will be held at Seabright, New Jersey, beginning on or about June 20, 1889. Seabright is on the Atlantic coast near Long Branch and within one hour's time of New York, by boat or rail. Arrangements as to transportation are in progress, and a rate of 1⅓ full fare for a round trip is expected.

Engineers' Club of Philadelphia.—Record of business meeting, May 4, 1889. Vice-President ARTHUR BEARDSLEY in the chair; 46 members present.

The Tellers of Election presented their report of the count of the votes upon the amendments to the constitution and by-laws, which were proposed at business meeting, April 6, 1889. The result was as follows:

No. of Article, etc.	*Total votes cast.*	*Aye.*	*No.*
CONSTITUTION.			
Art. III. (New article)	248	153	95
" IV	252	49	203
" V, VI and VII.			
BY-LAWS.			
Art. III	251	40	211
" IV, Sec. 3	241	112	129
" " " 5	230	113	126
" " " 7, 82	242	133	109
" " " 80	241	118	123
" VI " 2	230	71	159
" " " 3	230	114	125

No one of the above having received a favorable vote equal to two-thirds of the votes cast upon it, all of the proposed amendments failed to pass. (Article IV. of the constitution was the one proposing to deprive non-resident members of the power of voting. Article III of the by-laws proposed to abolish the letter ballot.—ED. ENG. NEWS.)

Mr. J. E. CODMAN presented a table of dimensions of pipe flanges and cast-iron pipes, for the Reference Book. The secretary *pro tem.* presented, for Mr. ROBERT A. CUMMINGS, a paper on color, which the author treats generally, as to contrast and as to harmony and qualities of colors.

Mr. ARTHUR MARICHAL called the attention of the club to a paper read before the Society of Civil Engineers, of Paris, by Mr. DECORDEMOY, in which he describes the recent improvements of the harbor of Bilbao, Spain.

Until these last years the harbor was protected by two parallel jetties 525 ft. apart. At the outlet of these jetties there was a bar preventing vessels of over 1,000 tons from entering the port. The engineer, Mr. DE CHURRUCA, proposed to build a single concave jetty. This was completed in 1888, when it was found that the channel was 11 ft. deeper than before. At this date, vessels of 18 to 22 ft. draft can enter the port easily. There was some discussion by Prof. L. M. HAUPT and others. Prof. LINO F. RONDINELLA explained two diagram tables, one of which gives graphically the relations of lines and areas in polygons, and the other the relation between English and metric measurements.

HOWARD MURPHY, *Secretary.*

Engineers' Club of St. Louis.—At the meeting on May 1, C. H. HOWARD and POPE YEATMAN were elected to membership. Mr. S. B. RUSSELL offered the following: "Whereas, The collection and exchange of data is a proper mission of the club.

Resolved, That the Executive Committee be instructed to compile a book of local data, to be presented for publication at the next annual meeting, the book to contain such information in regard to the materials of engineering in use in St. Louis and vicinity as can be collected and other memoranda of a local nature useful to engineers. The committee to call on such members as it may select for assistance in the compilation.

Mr. HOLMAN amended this resolution, substituting a Standing Committee to be appointed by the chair in place of the Executive Committee. The resolution as amended was then adopted. The chair appointed on this committee: S. B. RUSSELL, ROBERT MOORE and JOHN B. JOHNSON.

Prof. H. B. GALE read a paper on "A New Theory of Chimney Draft and the Design of Brick and Iron Stacks." The author had made numerous experiments to determine the different factors which entered into the problem and gave some formulæ in shape for convenient use. The difference between brick and iron stacks was discussed. He showed that while the area of a stack could not be reduced below certain limits, it could be increased without affecting the efficiency of the stack.

Mr. SEDDON'S paper on "Experiments on Settling Water" was deferred until the next meeting.

W. H. BRYAN, *Secretary.*

Denver Society of Civil Engineers and Architects.—The regular monthly meeting was held May 7: President

NETTLETON in the chair, 26 members present. The greater part of the evening was devoted to the discussion and adoption of a new constitution and by-laws. The Society tried to avoid some of the objections to the customs of many technical associations. Nominations for officers are made in open meeting one month before election. As many candidates may be nominated for each office as the members wish. Nominations may be made by letter. A plurality vote elects. The president may decide a tie vote, etc.

Major J. W. POWELL, Director of the U. S. Geological Survey, was elected an honorary member.

The officers of the Society for this year are as follows:

President, E. S. NETTLETON.

Vice-President, R. A. WILSON.

Secretary and Treasurer, W. W. FOLLETT.

Executive Committee, Prof. P. H. VANDIEST, F. E. EDBROOK and R. D. HOBART. (The President and Secretary are *ex officio* members of this committee.)

W. W. FOLLETT, *Secretary*.

Engineers' Club of Kansas City.—Meeting on May 6. After the regular business was transacted, a paper on the "Foundation for the Llimfjord Bridge" was read by Mr. O. F. SONNE. The bridge was built in 1874-78 across the Llimfjord, near Aalberg, for the Danish State Railways; it has 4 spans of 206-226 ft. and 2 draw spans of 88 ft. each. The piers were sunk by the pneumatic process through soft and tenacious mud, one of them to 59 ft., the six others to 111.55 ft. to 113.5 ft. below m. w.; they were built with iron caissons, the masonry of hard burned brick laid in Portland cement, the upper part protected by granite; they were lowered from scaffolds and kept suspended, during the sinking, each by four rods or chains hooked around the cutting edge. Through a combination of circumstances one of the piers was overturned, and it located on the centerline of the bridge; a new pier was lowered and had to be carried through the old one. The work was done under contract by the French firm *Compagnie de Fives-Lille*. KENNETH ALLEN, *Secretary*.

New England Railroad Club.—At the regular meeting on May 8, "Rules for the Interchange of Freight Cars" was discussed.

A communication from the Arbitration Committee of the Master Car Builders' Association was read, asking for suggestions as to amendments to the present interchange rules.

Mr. F. D. ADAMS said the rules should first of all be explicit. The following are points in which the rules need amendment: (1) How large a piece must be broken out of the wheel flange to charge the term "chipped" to "broken"? (2) Rule 27 says: "Cars shall be treated as belonging to the companies whose name or initials they bear." A large number of private cars run over our road and have a railway company's initials upon them. Nevertheless these companies refuse payment for repairs and the private companies who own the cars and are not bound by the interchange rules also refuse. (3) If a box is put in with a different style of lid upon it, but otherwise uniform and according to the rules, it ought not to render the car liable to rejection. (4) Any drawbar sound and reliable, of sufficient size and strength, should not be objected to. (5) Rule 6 reads, "Any company finding a car with defect card attached may make repairs noted by the card, provided such repairs are necessary for safe running of the car, and render bill for same."

Under this rule too much seems to be left to the judgment of inspectors. Some inspectors will stop for repairs every car with a card on it, and others will not repair at all unless it is really unsafe to run. It has been charged that some roads make a specialty of repairs in this way.

Referring again to the matter of "chipped" or "broken" wheels, it seems to me that there should be a definite size of piece that shall be broken from the flange to constitute it a broken wheel and make it a chargeable wheel. Chipped flanges are not chargeable. They are supposed to be occasioned by running over a bad frog. It is not an infrequent thing to find a piece broken out 5 or 6 ins. long, and if it is broken so badly, it seems to me that the wheel ought to be chargeable. I don't know that we can get any proof that frogs will break pieces out of a wheel so long as this; it might be a question.

Mr. MARDEN. The interchange rules are certainly of great benefit to the railway companies; but several of them need amendment. I would suggest that Rule 6 require two cards to be put on, one for new defects, the other for old defects, and the company that owns the car should be held responsible for old defects upon it. Difference in size of axles causes us a good deal of trouble, axles of smaller diameter are often put in in making repairs. We have trouble every day over "wrong material," especially as applied to draw-bars. Many roads have refused to receive cars with wrong box-lids. I have thought for many years that our system of interchange was very expensive, necessitating much clerical work, and that we might sometime in the future have something better. It seems to me that it would be no more than fair that we should take care of the repairs of the cars belonging to our road, whether they are on our own road or on other roads; the mileage we get for our cars on other roads should pay us for depreciation. There are two ways in which the repairs might be managed: We might take care of all the repairs of cars coming on to our road, making such repairs at our own expense, which would save a great deal of trouble in the matter of bills; or we might be allowed to make such repairs on foreign cars as would make them safe to run over our road; or if all would agree we might make these repairs permanent, in the way they should be made, according to the style of workmanship in the car, and make a proper charge to the road owning the car, thus keeping the rolling stock in good condition all around.

Mr. ADAMS thought that to repair all cars without charges would be an impracticable plan. Roads running cheap, contract-built cars would be glad of such an arrangement, but it would be an expensive one to the roads running a better class of cars. As regards old defects: no cars with old defects should be passed. He would vote for a rule providing that every car not in thoroughly good order should be stopped. That seems to be the only way out of the difficulty. "I agree with Mr. MARDEN that we ought not to receive cars without a good substantial draw-bar in them. We have had cars come home to us with draw-bars only half as heavy as our own put in, and have been unable to discover where it was done; and the man who has done it has put our initials on it, making other roads believe that we are using such a mean little draw-bar as that: and that is unfair as well as mean."

Mr. LAUDER commended the present interchange rules, and thought with slight amendments, as the necessity arose, they were the best possible to be devised.

Mr. ADAMS thought the reason Mr. LAUDER was so well satisfied with the interchange rules was because the Old Colony had so little to do with through line connections. The system as a whole works very well, but is susceptible of improvement.

The matter of repairs to private cars was discussed, and it was generally agreed that the rules should definitely fix the responsibility for the necessary repairs upon them.

It was voted that the next meeting of the Club be held on the second Wednesday in September.

The Georgia Road Congress to be held in Atlanta, Ga., May 22 and 23, will discuss the following papers: "The Utilization of the Convict Labor of Georgia," by Hon. HOKE SMITH, of Atlanta. "Permanent Improvement of the Public Roads as a factor in the Advancement of Civilization," by Hon. JOHN T. GRAVES, of Rome. "The Science of Permanent Improved Roads," by Prof. J. E. WILLET, Mercer University. "Power and Obligation of Government to Improve the Highways, and to what Extent that Power be Exercised in Fulfilling that Obligation," by CLIFFORD ANDERSON, Attorney-General. "The Science of a Permanent System of Improved Roads," by Prof. SHELTON P. SANFORD, of Mercer University.

New England Water-Works Association.—The eighth annual convention will be held at Fall River, Mass., on June 12, 13 and 14.

On Wednesday, June 12, business will be transacted and reports presented. A paper on "Hydrants," by GEORGE A. STACY, of Marlboro, Mass., will be read and discussed, after which there will be a topical discussion. In the evening Prof. J. E. DENTON, of the Stevens Institute of Technology, Hoboken, N. J., will address the association on "The best economy attained by the modern high expansion type of pumping engine compared with the best record of Cornish pumping engines during the time of Watt, as recorded by the Wicksted experiments." The lecture will be illustrated by lantern views.

On Thursday, June 13, officers will be elected and other business transacted. The following papers will be read: "Water-Works at Richmond, Va.," CHARLES E. BOLLING, Richmond, Va.; "Friction in the Collection of Meter Rates," GEORGE F. CHASE, Taunton, Mass.; "Water-Works Records," ALBERT S. GLOVER, West Newton, Mass.; "Recent Progress in the Biological Analysis of Water," Prof. W. T. SEDGWICK, Mass. Inst. Technology, Boston, Mass. There will also be topical discussions.

On Friday, June 14, there will be an entertainment. The associate members will have an exhibit of water-works appliances.

The following topics for discussion have been suggested by the Executive Committee:

I. "Suggestions as to the best method to set hydrants to prevent freezing."

II. "Suggestions as to the best method to prevent mains from filling with sediment."

III. "Should the sizes of mains and distribution pipes be materially increased to provide for carrying the amounts of water suggested by Mr. Sherman's paper without excessive loss of head?"

IV. "Should the public and public corporations be chiefly responsible for the sins of private corporations, and which, all things considered, is most conducive to public interests—water supply furnished by municipalities or by private corporations?"

V. "Suggestions as to the best method of repairing water pipes under water."

VI. "What is the lightest safe weight per foot for lead service pipes?"

VII. "What is the greatest allowable suction lift for pumping machinery?"

VIII. "The efficiency of water motors: Is it desirable to encourage their use?"

IX. "The effect of water hammer on main pipe, and how remedied."

X. "Consumption and waste of water per head per day in the United States, and how to reduce the waste.

XI. "What are the conditions required to warrant any hope of permanence of supplies obtained from driven wells?

HIRAM NEVONS, *President*, Cambridge, Mass.

R. C. P. COGGESHALL, *Secretary*, New Bedford, Mass.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Utica & Unadilla Valley.—The contract for the grading and masonry work on this road has been let to J. A. Seno, 400 Grand St., New York. The road is to run from Bridgewater, N. Y., to New Berlin, a distance of 20 miles. A. C. COUCH, of Bridgewater, is President.

Maine Central.—Work has been commenced on the extension from Fabyan's, N. H., to Scott's Station on the St. Johnsbury & Lake Champlain division of the Boston & Lowell R. R., a distance of 10 miles.

Delaware & Hudson Canal Co.—The Adirondack Railway running from Saratoga to North Creek, Warren county, a distance of 60 miles, is reported to have been purchased by this company.

Baltimore & Ohio.—It is announced that this company will build a branch from Fairchance, Pa., to Morgantown, W. Va., a distance of 17 miles. The line, if built, would, together with the Monongahela River R. R. now under construction, give Pittsburg a direct route to the coal and mineral fields of West Virginia.

Rockaway Valley.—Right of way for the extension of this road from New Germantown to Pottersville, 4 miles, is being obtained, and work will begin at once. As soon as work is in progress on the present extension, surveys for the further extension of the line to Peapack will be commenced. J. V. MELICK, of White House, N. J., is chief engineer.

New York, Lake Erie & Western.—A press report states that this company is surveying a line to run from its own road near Newark to Bound Brook, N. J., where it will connect with the Philadelphia & Reading R. R.

Columbus & Cincinnati Midland.—It is announced that this company has filed a certificate with the secretary of the State of Ohio asking to be allowed to increase its capital stock. The proposed increase is to aid in building extensions of the line south and east to the State line.

Kokomo Belt.—A correspondent sends us the following:

This company was organized by a number of the business men of the city of Kokomo, Ind., to build a railway for the purpose of reaching several factories situated on the outskirts of the city. The road is about 2½ miles long and does nothing but a freight business. It was built by the Chicago, St. Louis & Pittsburg R. R. Co.

Pennsylvania.—The directors of this company have voted to issue about $7,000,000 of stock to aid in the purchase of new rolling stock and the building of third and fourth tracks where they are needed.

Wabash Western.—The lines of this company east of the Mississippi river have been sold to representatives of the Wabash Western Purchasing Committee for the sum of $15,550,000. This amount secures the first and second mortgages in Ohio and the first of the remainder of the road. It is intended to consolidate the Wabash Railway and the Wabash Western into one system, to be called the Wabash R. R. Co. This will probably be effected within three months.

American Midland.—At a recent meeting of the stockholders, the directors of the company were authorized to bond the line as far as completed for a sum not exceeding $50,000 per mile. The money is to be used to liquidate the floating debt and extend the line to Red Bank, Pa., on the east, and to Fort Wayne, Ind., on the west.

Projects and Surveys.

Plymouth & Middleboro.—JAMES M. HODGE, of Plymouth, Mass., Chief Engineer, sends us the following:

The preliminary survey for this road, which is to run from Plymouth to Middleboro, a distance of 16 miles, has been made. The work is generally light. The maximum grade is 80 ft. per mile. The business of the road will be principally local. D. T. SHUMWAY, of Plymouth, is President.

Phillips & Rangeley.—The preliminary surveys for this Maine road are in progress. H. P. CLOSSEN, Gardiner, Me., is President.

North Avenue Railway Co. of Baltimore,—Incorporated in Maryland to build a passenger railway in Bal-

timore. Among the incorporators are: ISAAC S. GEORGE, FRANK SLINGLUFF, MILES WHITE, Jr., and WALLACE KING, all of Baltimore.

Maryland Midland.—This company has been incorporated in Maryland to build a line of railway starting from a point on the Green Spring branch of the Northern Central R. R. between Roger's Station and the junction of the Western Maryland R. R. with this branch, and running in a northerly direction to the State line. The capital stock is $50,000. Among the incorporators are CHARLES A. COUNCILMAN, GARRETT D. WATERS, JOHN CARROLL, and JACOB D. GRIST.

Central Pennsylvania.—Incorporated in Pennsylvania to build a line of railway from Mill Hill to Unionville a distance of 25 miles. SAMUEL H. HICKS, of Watsontown, Pa., is President.

Ottawa & Vaudreuil.—There is a prospect that work will soon commence on this road, which is projected to run from Ottawa to Montreal, P. Q.

SOUTHERN.—Existing Roads.

Georgia Southern & Florida.—This company has made an offer to the citizens of Thomasville, Ga., to build the branch from its main line to that place on condition that a bonus of $25,000 is raised, and terminal facilities and right of way into the town is granted by the citizens. The road is to be completed by Nov. 15.

Ohio River.—The annual report of this company for 1888 shows the following results of operations as compared with the previous year:

	1888.	1887.
Gross earnings	$471,804.64	$375,216.86
Operating expenses	260,568.76	194,382.91
Net earnings	$211,235.88	$180,833.95

Louisville Southern.—Work is being rapidly pushed on this road. The contractors have a force of 700 men at work in Madison county. The James Hill tunnel has been driven 48 ft. and the masonry and trestle work will be finished by the time the grade is ready for the rails. The engineers at work on the location from Richmond to Beattyville have found a favorable line.

Dayton & Faunsdale.—The grading is nearly completed on this Alabama road, and tracklaying will begin immediately.

Queen & Crescent.—It is reported that the Anniston & Cincinnati R. R., running from Anniston to Attalla, 35 miles, and the Anniston & Atlantic R. R., running from Anniston to Sylacauga, 53 miles, have been purchased by this company. The company proposes to broaden the gauge of the Anniston & Atlantic, and extend it from Sylacauga to Montgomery, a distance of 80 miles.

Louisville & Nashville.—It is stated that this company will soon commence work on its proposed line from Pineville through the Cumberland Gap to a connection with the Norfolk & Western, about 75 miles.

Cape Fear & Yadkin Valley.—This company is reported to be making surveys for a short extension of its Millboro branch.

Richmond & West Point Terminal.—This company has recently purchased the outstanding minority stock of the Richmond & Danville R. R. Co. amounting to 7,360 shares. It pays in payment for each share of the R. & D. stock one 5 per cent. Richmond Terminal bond at $85 and 6 shares of Richmond Terminal common stock at $26 each. The Terminal company now owns the entire outstanding stock of the R. & D. company, having purchased the remainder of the 50,000 shares some years ago.

Projects and Surveys.

Sheffield & Seaboard.—Arrangements are being made to commence work on this road, which is to run from Sheffield, Ala., to Aberdeen, Miss., a distance of 95 miles. Maj. BELTON MICKLE, of Sheffield, is Chief Engineer.

Parkersburg & Eli Narrow Gauge.—A project is on foot to build a narrow-gauge road from Parkersburg, W. Va., to Eli, W. Va., about 9 miles below the Little Kanawha river, where there are valuable coal deposits.

Sebree & Owensboro.—A company has been formed in Kentucky to build a railway from Sebree to Owensboro, a distance of 45 miles. The road will run through a fertile and well timbered country. Considerable of the stock has been taken by the people along the route.

Florida.—Bills have been introduced into the Florida Legislature to incorporate the West Florida & Alabama R. R. Co., the Fernandina & Suburban Ry. Co., and the Manatee River Ry. & Navigation Co.

Rutledge & Julian.—This company, which proposes to build a railway from Julian Station, on the Northwest & Florida R. R., to Rutledge, Ala., a distance of 3 miles, has organized with the following officers: B. A. WALKER, President; E. F. DYER, Treasurer; and M. WALKER, Secretary. The general offices of the company will be at Rutledge.

St. Louis & Birmingham.—E. W. LINN, C. A. NYE, E. R. CAMPBELL and others of Nashville, Tenn., have incorporated a railway company by this name.

Anniston & Montgomery.—At a recent meeting of the stockholders the following officers were elected: President, JOHN W. NOBLE; Vice-President, WILLIAM NOBLE; Secretary, JOHN B. REES, and Chief Engineer, E. G. ROBERTS. They expect to commence work about the first of June.

Madisonville & Owensboro.—A project is being agitated by the citizens of Madisonville, Ky., to build a line of railway from that place to Owensboro, a distance of about 50 miles.

THE NORTHWEST.—Existing Roads.

Duluth, Red Wing & Southern.—It is expected that work will soon begin on the section of this line between Zumbrota and Albert Lea, and the road be in operation from Red Wing to Albert Lea before the end of the season. The road is projected to run from Duluth, Minn., to Sioux City, Ia., about 425 miles. WM. DANFORTH, of Red Wing, Minn., is Chief Engineer.

Chicago, St. Paul, Minneapolis & Omaha.—Engineers have commenced the survey of an extension to run from Hartington, Neb., to Yankton, Dak., a distance of about 24 miles.

Chicago, Burlington & Quincy.—A Nebraska correspondent states that work on the line of the Burlington & Missouri River R. R. running from Alliance, Neb., to the Wyoming coal fields has been practically discontinued.——This company has recently acquired large terminal facilities in St. Louis, Mo., by the purchase of a tract of land containing about 400 acres running from Hall St. east to the river and embracing the entire river front.

Northern Pacific.—Work has been commenced on the Little Falls cut-off by Winston Bros., of Minneapolis, Minn., the contractors. The company has also authorized the extension of the Missoula & Bitter Root Valley branch a distance of 30 miles.

Grand Tower & Cape Girardeau.—D. E. Garrison & Co. of St. Louis, who have the contract for building this road, which is to run from Grand Tower to East Cape Girardeau, a distance of 28 miles, have completed about 6 miles of the grading.

Burlington, Cedar Rapids & Northern.—The annual report of this company for 1888 shows the following results from operations:

Gross earnings	$2,848,075
Operating expenses including taxes	2,066,629
Net earnings	$781,446

Wausau, Merrill & Abbotsford.—About 200 men are at work on this Wisconsin road between Abbotsford and Black Creek Falls. ALFRED A. KROUSE, of Milwaukee, is interested.

Chicago & Northwestern.—There is a report in circulation that this company intends to extend its line from Hastings, Neb., to Denver, Col., and will begin work on construction at once. This would seem, on the face of it, to be quite improbable.

Northern Pacific & Manitoba.—Track laying has reached the Assiniboine river southeast of Portage la Prairie and work is now in progress on the bridge across the river at that point. It is expected that the bridge will be completed within 6 weeks.

Chicago, Burlington & Quincy.—The annual meeting of the stockholders of this company was held at Chicago, May 15. There were 430,000 shares of the stock represented. The old Board of Directors was re-elected.

Projects and Surveys.

Forest City & Watertown.—Surveyors are at work locating this line between Gettysburg and Watertown, Dak., about 10 miles. The engineers who have been making the preliminary survey through the Sioux Indian reservation report that a very favorable route can be secured and that the country is far more fertile and wooded than was supposed.

Centralia & Altamont.—JACOB GROSCH, of Centralia, is President and B. HAUPTEN is Secretary of the company, whose incorporation was noted in our issue of May 4.

Pierre & Puget Sound.—A company has been organized in Dakota to build a line of railway from Pierre, Dak., to Puget Sound. The line will run through the Sioux reservation, the Black Hills, the Yellowstone National Park, Idaho, and Oregon, to a terminus on Puget Sound. The capital stock is $50,000, which has all been paid in. This money will be used in making surveys. Among those interested are R. F. PETTIGREW and S. M. BAILEY Jr., both of Sioux Falls, Dak.

Wabash Eastern.—Incorporated in Illinois with a capital stock of $12,000,000 to build lines of railway running from a point on the Wabash Western R. R. in Vermilion county across the State to a point on the Mississippi river near Hannibal, Mo.; from Decatur to east St. Louis, and from Chicago to Altamont. Among the incorporators are GEO. W. SMITH, ABRAM M. PENCE and CHARLES HENROTIN, of Chicago, and JOHN W. BURNS, of Springfield, Ill.

Sparta & Ste. Genevieve.—The officers of this company, whose incorporation was noted in our issue of April 27, are: T. F. ALEXANDER, President; W. D. M. ECKER, Vice-President; D. P. BARTON, Secretary, and W. H. SCHMITT, Treasurer; all of Sparta, Ill.

Black River Falls & Eastern.—HUGH H. PRICE, of Black River Falls, Wis., President of this company, sends us the following information concerning the enterprise:

This road is to run from Black River Falls via Alva to a connection with the Green Bay, Winona & St. Paul Railroad, a distance of about 23 miles. The surveys have been completed. The work is light with easy grades and very little bridge work. The principal business of the road will be in lumber, iron and coal ore and pig iron from the large iron works along the route. The right of way has been secured. The construction work will probably be done by the company. It is expected to begin track laying by September. The company was incorporated March 14, 1889. A. S. COOPER is chief engineer.

THE SOUTHWEST.—Existing Roads.

Missouri Pacific.—It is stated that surveys are in progress for a road to run from Fort Scott, Kan., to Rich Hill, Nevada, or Hume, Mo., to form an independent line from St. Louis to Wichita. At present these trains run over the Missouri, Kansas & Texas R. R. from Fort Scott to Nevada.—E. P. Reynolds & Co., who had the contract for building 25 miles of the road from Coffeyville, Kan., to Wagoner, Ind. T., have nearly completed their contract.

Texas Western Narrow Gauge.—This road, which runs from Houston, Tex., to Sealey, Tex., a distance of 53 miles, has been sold to New York parties. The road was originally intended to run from Houston, Tex., to Presidio del Norte, Tex., a distance of 600 miles. It is stated by the purchasers that the road will either be extended as projected, or a connection will be made with some other road.

Denver, Texas & Fort Worth.—It is reported that grading will soon begin on the extension of this road from Trinidad, Col., to the coal mines on the Maxwell land grant, about 30 miles.

San Antonio & Aransas Pass.—A force of about 100 men are now giving the finishing touches to the Houston extension of this road. The Brazos bridge is completed, and the entire line from San Antonio to Houston, 237 miles, will be open for traffic by May 20. ——Work is being rapidly pushed on the extension from Comfort to Llano.

Cleveland, St. Louis & Kansas City.—Work has been stopped on this road by the contractors, Wm. Baird & Co., of Pittsburg, Pa., on account of lack of funds. Six miles of track and 56 miles of grading had been completed by the contractors. The road is now open for traffic from St. Charles, Mo., to Hamburg, 16 miles, 10 miles having been completed before the present contractors commenced work. It is expected that new arrangements will be made and work resumed within a few weeks.

St. Louis, Arkansas & Texas.—The Central Trust Co. of New York has filed application for a receiver for this company before Judge PARDEE, of the United States Court, at Tyler, Tex. Col. S. W. FORDYCE was appointed receiver.

Kansas City, Fort Scott & Memphis.—The annual report of this company for the past year shows the following results from operations as compared with 1887:

	1888	1887
Gross earnings	$4,344,488	$4,771,168
Operating expenses	2,922,996	3,007,495
Net earnings	$1,421,492	$1,763,673

Projects and Surveys.

Camden & Alexandria.—C. G. HENDERSON, of Camden, Ark., President of this company, sends us the following information:

This road is to run from Camden via Eldorado and Winfield to Alexandria, La., a distance of 175 miles. The maximum grade is 1 per cent. and the maximum curve is 6°. There will be one bridge at Alexandria. The business of the road will be the transportation of cotton, timber and a general freight and passenger traffic. Contracts will be let about July 1. It is expected that tracklaying will begin about September 1, and the road be opened for business by November. N. R. SMITH, of Camden, is chief engineer.

Texarkana & Daingerfield.—Incorporated in Texas to build a railway from Texarkana to Daingerfield, a distance of about 50 miles.

ROCKY MT. AND PAC.—Existing Roads.

San Diego & Eastern Terminal.—A press report from San Diego, Cal., states that grading has commenced on this road, between Old Town and Roseville.

Marysville, Sutter City & Colusa.—Construction has begun upon this California road and it is expected to have it in operation from Marysville to Sutter City by July 4. The road will probably be extended to Colusa as soon as substantial aid has been offered by the people along the route. ALEX. BADLAM, of San Francisco, is president.

Canadian Pacific.—This company has called for tenders for the grading of the Missouri branch from New Westminster across the Fraser river to the International boundary.

Southern Pacific.—A San Francisco press dispatch quotes General Manager A. N. TOWNE as saying that negotiations were pending for a transfer, either by lease or purchase, of the Northern California R. R., between Marysville and Oroville, to this company.——About 100 men are at work on the extension of the Monterey R. R. from Monterey along the shore of the Bay of Monterey to Carmel Bay.

Denver & Rio Grande.—The extension of this road from Glenwood to New Castle, Col., has been opened for traffic.

Projects and Surveys.

Spokane Falls & Rockford.—This company, whose organization was noted in our issue of May 4, has been incorporated to build a railway from Spokane Falls, W. T., to Rockford, W. T., a distance of 21 miles. The incorporators are: A. M. CANNON, E. J. BRICKEL, CHAS. J. SMITH, and WM. K. KENNEDY, all of Spokane Falls.

Montana & Canada.—The officers of this Montana company are S. F. HAUSER, president; W. G. CONRAD, vice-president; GEO. A. HILL, secretary, and O. R. ALLEN, treasurer.

Los Angeles, San Diego & Yuma.—The City Council, of Los Angeles, Cal., has granted this company right of way through the city on condition that 25 miles of the road be built this year.

Portland & Clackamas.—Incorporated in Oregon, with a capital stock of $500,000 to construct branch lines of railway from Oswego, Clackamas county, to a connection with the Oregon & California R. R., in Marion county, to East Portland, Powell's Valley, and other points. The incorporators are WILLIAM REID, T. E. HABERSHAM, and D. W. CUMMINS. The principal offices will be at Portland, Ore.

FOREIGN.

Argentine Northeastern.—This company has made an issue of $2,940,000 of bonds to aid in the construction of its road. This company was incorporated in 1887 to build two lines of railway to run from the town of Monte Caseros, the northern terminus of the East Argentine Railway, northeast along the valley of the Upper Uruguay river to Posedas, a distance of about 284 miles, and from Monte Caseros northwest to the city of Corrientes, a distance of about 230 miles. About 5,000 men are at work on the line and the earthwork is practically completed. On the line to Corrientes, it is expected that 2 sections of about 37 miles each will be opened for traffic this summer and a third section of the same length by the end of the year. On the Posedas line, work is being pushed, and a portion will probably be opened early next year. Both lines pass through one of the most fertile and healthy portions of the Republic. J. E. & M. Clark & Co., of London, Eng., have the contract to build the line and are to have it completed by May, 1893. The Argentine National Government subsidizes the road by guaranteeing for 20 years from the opening of the road by sections, 6 per cent. interest payable semi-annually on $30,500 per kilometre, which would amount to $1,471,350 per annum. All property of the company is exempt from taxation, both national and provincial. George Berkley & Son, 57 Charing Cross, London, Eng., are the engineers of the company.

Paraguay Central.—This company has been formed to acquire and work the Government Railway from Asuncion to Villa Rica, a distance of 92 miles, 45 miles of which are already in operation, and to further extend the road 136 miles to Encarnation on the River Parana opposite Posedas, the terminus of the Argentine Northeastern Ry. now under construction. The Government of Paraguay subsidizes the company to the amount of $510,000.

Interoceanic.—Construction is being rapidly pushed on this Mexican road and it is expected to have it completed to Vera Cruz and Matisac in less than a year. There is enough construction material on the ground to complete the road to those points and the cars and locomotives have been ordered.

Mexican Central.—The line from Aguas Calientes to San Luis Potosi, a distance of 130 miles, will be finished this month. A portion of the road from Aguas Calientes to Salinas, a distance of 50½ miles was built in 1888.

Mexican National.—A press dispatch from Brownsville, Tex., states that this company has transferred the contracts for the completion of the line, now in operation from Matamoros to San Miguel, 75 miles, to the proposed terminus at Monterey, to Gen. BERNARDO REYES, ex-Governor of Nuevo Leon, and others, and that the road will be immediately pushed to completion.——A movement is on foot to build a break-water and railway from Point Isabel across the Laguna del Madre to Brazos Island.

RAPID TRANSIT.

Cable Railways.—***Washington, D. C.***—The Washington & Georgetown St. Ry. Co. will put in a cable system. Mr. DANIEL BONTECOU, of Kansas City, Mo., is the engineer.

St. Louis, Mo.—Contracts have been let for the 4th St. cable line, and the road is to be completed in 4 months.

Portland, Ore.—The Portland Cable Ry. Co. has begun work. Mr. GEO. W. LYNCH is General Manager.

San Francisco, Cal.—The California Street Ry. Co. has been granted a franchise for a cable road.

Dummy Lines.—***Opelika, Ala.***—It is proposed to build a dummy line to Auburn.

Fort Payne, Ala.—The Fort Payne Land & Enterprise Co. will build dummy lines. President, JOHN R. SHIELDS, of Birmingham.

Jacksonville, Ala.—The Jacksonville, Williamsport & Anniston Ry. Co. will extend its dummy line 4 miles to the East & West Alabama Ry., and will also build 5 miles of branches. The rails will weigh 60 lbs. per yd.

St. Augustine, Fla.—The St. Augustine & North Beach Ry. Co. has engaged an engineer to make surveys and estimates for the proposed dummy line.

Liberty, Kan.—Tracklaying for the Winner dummy line has been commenced at Hariem, and a large consignment of rails has been received.

Trinidad, Col.—A 20 years franchise for a motor line has been applied for by A. B. EADS and FRANK MILLER, of Denver, and H. J. ALEXANDER and L. B. COLLIER, of Trinidad. They propose to build 3 miles this season.

Street Railways.—***Springfield, Mass.***—The street railway company will build the extension of its West Springfield line to Mittineague at once; it will ultimately be extended to Chicopee, making a belt line with the Brightwood road.

Allegheny, Pa.—Several new street railways are to be built; some of them will be electric lines.

Richmond, Va.—The Richmond City Ry. Co. will relay 4 miles of line with new ties, stringers and rails.

Portland, Ore.—The Oregon Water & Street Ry. Co. has been incorporated by E. G. HUGHES, C. X. LARABEE and H. Y. THOMPSON. Capital stock, $100,000.

Vancouver, Wash. Ty.—The Columbus Land & Improvement Co. is building a street railway.

Dallas, Tex.—The Dallas City & Suburban Street Ry. Co. has been incorporated. Capital stock, $100,000.

Electric Railways.—***Brunswick, Me.***—The Thomson-Houston Co. will probably build an electric line to Topsham.

Plainfield, N. J.—The Plainfield Street Ry. Co. has made a proposition to operate a line on the storage-battery system.

Atlantic City, N. J.—The electric line owned by the Pennsylvania R. R. has been opened. The Sprague system is used.

Bay City, Mich.—The Bay City Street Ry. Co. has contracted with the Sprague Co. for the equipment of 5 miles of track and 8 cars with the electric system.

Decatur, Ill.—The Decatur Electric Street Ry. Co. is at work on its line. The Johnson girder rail is used for the track. The Detroit Electrical Co. supplied the electrical apparatus and the Pullman Car Co. built the cars. There are two 100 H. P. engines.

Sioux City, Ia.—The Sioux City Street Ry. Co. has been granted an extension of its franchise on condition that it equips the road with some electric system.

Denver, Col.—The South Broadway Electric Ry. Co. will extend its line to Littleton, a distance of 8 miles. The Thomson-Houston system will be used.

Omaha, Neb.—The Omaha Street Ry. Co. is building an electric line across the city.

Portland, Ore.—The Metropolitan Ry. Co. will build an electric line 4 miles long this season. Major SEARS is the engineer.

East Portland, Ore.—An electric railway is projected to North Albina, and $15,000 have been subscribed.

Spokane Falls, Wash. Ty.—An electric railway 4 miles long is to be built.

CONTRACTING.

Granite Blocks.—The following proposals for granite block paving have been received by JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. The three classes are for different districts and the prices do not include flagging:

In the first class the bidders were John H. O'Rourke, at $2.45 per sq. yd.; Thomas Monahan, $2.19; E. M. Lynch, $2.47; William Kelly, $2.53; Charles Guidet, $2.95; Charles Hart, $2.65; Henry Mogk, $2.80. In the second class: John H. O'Rourke, $2.55 per sq. yd; William Kelly, $2.48; E. M. Lynch, $2.47; Charles Guidet, $2.62; Thomas Monahan, $2.19; John McNamee, $2.48. In the third class: John McNamee, $2.48 per sq. yd; Thomas Monahan, $2.37; John H. O'Rourke, $2.29; Charles Hart, $2.55; William Kelly, $2.50.

Cement.—The following proposals for furnishing 500 bbls. of quick-setting Portland cement have been received by the Docks Commissioners: James Brand, $2.43 per bbl.; Francis G. Brown, $2.43; Marcial & Co., $2.44; Empire Warehouse Co., $2.45; E. W. Fisher, $2.50. The contract was awarded to James Brand.

Harbor Work.—The contract for repairing the west pier at Dunkirk Harbor, N. Y., has been awarded to L. HARBRECHT & Co., of Buffalo, N. Y., by Capt. F. A. MAHAN, U. S. Engineer Office, Buffalo, N. Y.: hemlock, white pine and white oak timber in place, $23, $33 and $35 per 1,000 ft. B.M.; $2.35 per cu. yd. for filling; $1.50 per cu. yd. for stone replaced; drift bolts, 3⅛ cts. per lb.; spikes, 3¼ cts. per lb.; screw bolts and washers in place, 4¼ cts. per lb.; treenails, $6 per 1,000; $1,500 for removing old cribs and leveling stone.

Capt. F. A. MAHAN, U. S. Engineer Office, Buffalo N. Y., has awarded the contract for iron moorings at the breakwater, Buffalo, to Daniel McNaughton, of Buffalo, at 16 cts. per lb. of mooring rings, 7 cts. per lb. for anchoring rods, and 4 cts. per lb. for anchoring plates.

Sewers.—***Brookline, Mass.***—The contract for 1,100 ft. of pipe sewer has been awarded by the Selectmen to E. F. Bingham at $814.30.

Pittsburg, Pa.—The Department of Awards has awarded contracts as follows: 12-in. pipe sewer on Larkins alley to P. O'Donnel at 79 cts. per ft.; 12 and 18-in. pipe on Carey alley at 92 cts. and $1.16 per ft.; 18-in. sewer on Fifth St. at $1.54; 9, 20, and 24-in. sewer on Anderson St. 60 cts., $1.07, and $2.85 per ft. to Ott Bros.; 9 and 15-in. sewer on Center Ave. at 65 cts. and $1.04 per ft., and 15-in. sewer on Meyran St. at 82 cts. per ft. to P. O'Donnell; 20 and 24-in. sewers on Bayard and Neville streets at $2.54 and $2.98 per ft. to James McKnight; 20 and 24-in. pipe and 3-ft. brick and stone sewers on Howe, Holden, O'Hara, and Summerlea Sts. to L. Sloan, at $2.50, $3, and $5 per ft.; 4, 4½, 5, and 5½-ft. brick and stone sewer on Butler St., from Fifth Ave. to Penn Ave., to Booth & Flinn, at $8.97, $9, $10.22, and $14.07 per ft.; 3, 3½, 4, 4½, and 5-ft. brick and stone sewer on Haight St. from Stanton Ave. to Allegheny river, to W. J. Dunn, at $5.22, $6.25, $7.20, $7.34, and $7.85 per ft.

Chattanooga, Tenn.—The contract for the Broad St. sewer has been awarded by City Engineer J. A. FAIRLEIGH to GEO. L. GILLESPIE for $10,709. The contract prices are as follows: $7.27 per lin. ft. for 50 x 75-in. brick; $10.31½ per ft. for 50 x 75 brick sewers with granite invert; 80 cts. per cu. yd. for solid rock excavation; $83.75 for each catch basin; $80 for each manhole; $572 for outfall complete. The other bids were as follows: Tennessee Contracting & Building Co., $13,190; Gillespie & Lee, $13,500; Darnley & McDonald, of St. Louis, $13,760; W. P. White, $15,468.60; Geo. O. Tenney, of Decatur, Ala., $15,609. Contracts for about $25,000 worth of sewers will be let May 21.

Omaha, Neb.—The Board of Public Works has awarded the contract for an 8-in. pipe sewer to J. O. Corby at 77 cts. per ft.

Dredging and Dikes.—The following bids were received May 6 by Gen. S. T. ABERT, U. S. Engineer Office, Washington, D. C.: Dredging in Chickahominy river, Va.: American Dredging Co., 14 cts. per cu. yd. Dredging in Pamunky river, Va.: American Dredging Co., 18 cts. per cu. yd. if contract for removing wreck is awarded. No bids for dredging in the Rappahannock, and only 2 informal bids for spur dike. The proposals for removing wreck of barge *Amicus* from the Pamunky river were as follows: J. H. & C. H. Denmead, West Point, Va., $800; W. H. French, Norfolk, Va., $1,195: American Dredging Co., $1,200; G. W. Gray, Georgetown, D. C., $2,250.

Pier Work.—The Docks Department has received the following bids for repairing crib bulkhead at Tompkins St., and building new pier at Rivington St., East river: John Gillies, $4,000 for bulkhead, $27,448 for pier; B. S. Cronin, $5,300, $28,000. P. Sanford Ross, $6,100, $30,350. Joseph H. Cofrode, $5,100, $34,900. The contract was awarded to John Gillies.

Dredging and Rip Rap.—The only bid received by Major W. R. LIVERMORE, U. S. Engineer Office, Newport, R. I., for rip rap at Block Island, R. I., was from W. H. Molthrop & Co., of New London, Conn., $1.72 per ton of 2,000 lbs. No bids were received for dredging.

Asphalt Paving.—At Albany, N. Y., it has been decided to lay asphalt pavement on Delaware Ave., and a similar pavement has been proposed for other streets.

At Newark, N. J., a company is being organized to lay sheet asphalt pavements on the process of Moses F. Higbie, of Perth Amboy. They will use a mixture chiefly composed of calcined pulverized clay and hot asphalt.

Trestle.—The contract for building 120,000 ft. B. M. of trestle on the Columbia, Newberry & Laurens Ry. has been awarded to Rice & Coleman. CHARLES ELLIS, Jr., of Columbia, S. C., is the chief engineer.

Stone.—A contract for 200,000 cu. yds. of stone for revetment has been awarded to Mathingly & Gunning, of Vicksburg, Miss., at $1.44 per cu. yd. on board U.S. barges.

Lead.—The Department of Awards, Pittsburg, Pa., has awarded the contract for 100 tons of pig lead to Bailey, Farrell & Co., at $78 per ton.

Street Work.—***Omaha, Neb.***—The Board of Public Works has awarded contracts as follows for paving: J. Ryan & Co., cypress blocks on concrete, $1.62 per sq. yd.; J. B. Ryan & Co., cedar blocks on concrete, $1.61 per sq. yd.; Kansas Paving & Construction Co., Colorado sandstone on sand, $2.17; the same with Galesburg vitrified brick on concrete, $1.93; James and Patrick Fox, Woodruff sandstone on sand, $2.19; James Forrestall, Sioux Falls granite on sand, $2.27; E. W. Naigle, cypress blocks on sand and plank, $1.59; J. E. Rielly & Co., cedar blocks on sand and plank, $1.34½; Kansas Paving & Construction Co., Colorado sandstone on sand (alleys), $2.17; James and Patrick Fox, Woodruff sandstone on sand, $2.29; James Forrestall, Sioux Falls granite on sand, $2.37; Barber Asphalt Paving Co., asphaltum on streets, form A, $2.9; form B, $2.68, and form C, $2.48. The following contracts for curbing were awarded: Kansas Paving & Construction Co. per lin. ft., $1.35 for first-class granite, or Colorado sandstone 75 cts.; J. B. Smith & Co., Berea sandstone, per ft., 60 cts.

Ogden, Utah.—The following proposals for grading have been received by the Street Committee: A. Patterson & Co., 40 cts. per cu. yd. James Burrup and S. Hallowell, 22½ cts. per cu. yd. for soil; cement, 40 cts., and $1.50 for every tree removed. Corey Bros. & Co., 22½ cts. for earth; 37½ cts. for cement. Joseph Belknap, earth, 42 cts.; hard-pan, 75 cts.; gravel 75 cts. G. Browson, earth,

29¼ cts.; gravel, 39 cts.; cement 59 cts. A. Toponce, earth, 37½ cts.; gravel, 47½ cts.; hard-pan, 75 cts. James Boyle, earth, 32 cts.; gravel, 42 cts.; hard-pan, 65 cts.

PROPOSALS OPEN.

Sewers.—Construction of system in accordance with plans prepared for the Council. THE CITY CLERK, Yankton, Dak.

Levees.—THE STATE BOARD OF LEVEE COMMISSIONERS, Baton Rouge, La.

Bridge.—Pile bridge over the Sudbury river. Plans, and specifications on file. THE ROAD COMMISSIONERS, Concord, Mass. May 22.

Pipe Laying.—THE COMMISSIONERS OF PUBLIC WORKS, 31 Chambers St., New York City. May 23.

Culvert.—Rubble arch culvert at Center St., Medina, N. Y. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. May 23.

Water-Works.—Complete system. F. P. BAXTER, mayor, or J. A. C. LUSK, recorder. Johnson City, Tenn. May 23.

Street Work.—Macadamizing Bedford Ave. JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. May 25.

Bridges and Culverts.—Seven wooden bridges with stone abutments, 1 iron bridge with stone piers, 4 stone culverts. Plans and specifications on file. FRANK J. O'FLAHERTY, County Surveyor, Kansas City, Mo. May 27.

Dredging.—In the North river; 75,700 cu. yds. THE DOCK COMMISSIONERS, Pier A, North river, New York City. May 28.

Water Tower.—Brick water tower at the Hospital of the Insane, at Winnebago, Wis. Architects, CONOVER & PORTER, Madison, Wis. CHARLES LULING, President, State Board of Supervision, Madison, Wis. May 29.

Natural Gas Plant.—Pipe, fittings, etc. FRANK MCWHINNEY, President of Board of Trustees of Natural Gas Works, Greenville, O. May 29.

Bridge.—Across the Wabash river at Main St. High truss wrought-iron bridge; 1 span of 181¾ ft., 2 of 180 ft. c. to c. of pins; 11 panels; truss 29 ft. deep c. to c. of chords; roadway 25 ft. clear width, 2 sidewalks 8 ft. wide; trusses proportioned for rolling load of 3,000 lbs. per lin. ft. of bridge; floor beams, beam hangers, hip verticals and sikewalks proportioned for rolling load of 100 lbs. per sq. ft. of floor surface, with a coefficient of safety of 4. Strain sheets must accompany bids. Also bids for abutment. EVERETT B. VAWTER, Superintendent and Engineer for County Commissioners, Auditor's Office, LaFayette, Ind.—Abutment, May 30. Superstructure, May 31.

Asphalt Paving.—About 2,000 sq. yds. of asphalt pavement and 1,800 sq. yds. of asphalt walks. Col. JOHN M. WILSON, U. S. A., Office of Public Buildings and Grounds, War Department, Washington, D. C. June 4.

City Hall.—Plans and specifications at the office of CHARLES E. COLTON, Syracuse. THE CITY HALL COMMISSIONERS, Syracuse, N. Y. June 6.

Dredging.—In Bayou La Fourche. Capt. W. L. FISK, U. S. Engineer Office, New Orleans, La. June 10.

Coffer Dam.—Harlem river improvement. Constructing coffer dam; excavating 90,000 cu. yds. of material from the cut through Dyckmans meadow and revetting slopes of cut. Lt. Col. G. L. GILLESPIE, U. S. Engineer Office, New York City. June 11.

MANUFACTURING AND TECHNICAL.

Railway Equipment.—Narrow gauge locomotives, mine cars, 200 tons of 25 lb. rails, splice bars, spikes, etc., are wanted by J. D. Kase, Danville, Pa., for delivery at Chattanooga, Tenn.

The Rutledge & Julian Ry. Co., wants rails, locomotive and cars for a line 3 miles long. M. TUCKER, of Rutledge, Ala., is Secretary.

The Wilson Lumber Co., of Wilson, Ala., wants 100 tons of 16 lb. rails, engine and cars for a narrow gauge logging road.

Cement.—The Buckeye Portland Cement Co., of Bellefontaine, O., improved its works last year, and can now turn out 500 bbls. per day. The main building is 200x40 ft., 3 stories high, and the kiln is 40x40 ft. and 90 ft. high The company proposes to build a cooper shop and make its own barrels. President, GEO. H. KALTAYER, of San Antonio, Tex.; Secretary, C. BAUMBARGER; Manager, G. W. BARTHOLOMEW. Mr. KALTAYER is also president of the Alamo Cement Co., of San Antonio, Tex.

Derrick.—Wolff & Zuricker, of Portland, Ore., are building a large derrick for Capt. W. YOUNG, U. S. Engineers, for the government work at Yaquina.

Frogs.—The Anti-Railway Frog. Co. has been organized at Chicago, Ill., to manufacture substitutes for frogs, and other railway appliances. A. A. ACKERLY, W. P. GRAVES and L. BARTLETT. Capital stock, $3,000.

The National Dredging Co. has been organized at Alexandria, Va. President, F. A. REED; Secretary, WM. REARDON. Capital stock, $50,000.

Pump.—The water-works at Huron, So. Dak., have for sale a duplex Blake pumping engine of 1,000,000 galls. daily capacity, and two 60 H. P. return flue boilers. They have been in use for 2 years. Address ALEX. MCINTOSH, Water Commissioner.

Priestman Petroleum Engine.—A few months ago Priestman Bros., of London, England, exhibited at 106 Washington St., New York, two of their patent oil engines, and proposed to make arrangements to have them manufactured in this country; up to the present time, however, these arrangements have not been completed, but it is hoped to do so shortly. In the meantime the London firm will be glad to execute any orders from this country. A number of recent testimonials have been received from parties in England who are using the engines for driving electric light plant, machinery, etc. The engine was fully described in ENGINEERING NEWS, Nov. 17, 1888, and its advantages were then pointed out.

Lighthouses.—The Russell Wheel & Foundry Co., of Detroit, Mich., is building 3 iron lighthouses for the government; they are to be erected at Crabtree ledge, Me.; Lubec narrows, Me., and Deer Id., Boston harbor, Mass. They are to be completed by July 15.

Axle Boxes.—The Port Townsend Foundry & Machine Co., of Port Townsend, Wash. Ter., is making axle boxes for the Kreitch Car Axle Box Co.

The American Bridge & Iron Co., of Roanoke, Va., has placed an order with the Roanoke rolling-mills for 500,000 lbs. of iron for bridges on the Norfolk & Western Ry. The works will be in operation by June, and orders are on hand for elevators, flour mills, furnaces, etc., aggregating over 1,000,000 lbs.

Locomotives.—The Schenectady Locomotive Works, of Schenectady, N. Y., have built a powerful Mogul engine with 5 ft. 9 in. driving wheels for the Chicago, Milwaukee & St. Paul. It is reported that the engine is guaranteed to make 60 miles an hour with 15 passenger cars. The engine and tender weigh 80 tons.

The Taunton Locomotive Works, of Taunton, Mass., have turned out an engine for the Mexican Central.

The Baldwin Locomotive Works, of Philadelphia, Pa., are building a consolidation engine for the Northern Pacific which will be No. 10,000 built at these works.—A dummy engine has been shipped to the West Rome Railway, of Rome, Ga.

The Baltimore & Ohio has 70 locomotives under contract to be delivered by July.

Cars.—The J. M. Jones Car Works, of West Troy, N. Y., are turning out 3 cars a day for the East Boston Street Railway Co.

The J. G. Brill Co., of Philadelphia, Pa., have built 6 cars for the electric railway at Nashville, Tenn. They are 16 ft. long and 7 ft. wide, and are fitted with Thomson Houston motors.

The Erie Car Works, of Erie, Pa., are building 500 coal cars for the Lehigh Valley.

The Barney & Smith Mfg. Co., of Dayton, O., is building 20 emigrant sleepers for the Northern Pacific.

The Lafayette Car Works, of Lafayette, Ind., are building 50 refrigerator cars for the Ohio & Mississippi.

The Indianapolis Car Works, of Indianapolis, Ind., have built a number of flat cars for the Kentucky Union.

The Ohio Falls Car Works, of Jeffersonville, Ind., have orders for 25 box cars and 30 hopper cars for the Louisville & Nashville, and 6 passenger cars for a western road.

The Pullman Palace Car Co., of Pullman Ill., has built 16 vestibuled cars for the new limited express on the Chesapeake & Ohio.

The Brownell & Wight Co., of St. Louis, Mo., has built the cars for the dummy line at Alton, Ill.

The East Tennessee, Virginia & Georgia has put on 2 Union boudoir sleeping cars to run between Brunswick and Atlantic.

The Baltimore & Ohio has 26 passenger cars, 4 baggage cars, 6 mail cars, 500 box cars and 300 flat cars under contract to be delivered by July.

BRIDGES AND CANALS.

Bridge Notes.—*New London, Conn.*—Work is reported to be progressing satisfactorily on the railway bridge over the Thames river.

Syracuse, N. Y.—A bridge is being built by O. F. Hilt, contractor, of Greenbush, N. Y.

Niagara Falls, N. Y.—The new suspension bridge was opened May 7. It is 1,260 ft. long, 17 ft. wide and 197 ft. above the water. The engineer was Mr. G. W. MCNULTY, and the contract was let to the Rochester Bridge & Iron Works, of Rochester, N. Y.

Paterson, N. J.—The Passaic County Board of Freeholders have decided to build a bridge over the Passaic river at 33d St., and another at Passaic City; also to rebuild the Rutherford bridge.

Newark, N. J.—The two new iron drawbridges of the Newark & New York Ry., across Newark bay and the Passaic river, are now operated by steam; the time consumed in opening or closing the draws is reduced from 7 or 10 minutes to 1 minute.

Oceanic, N. J.—Dean & Westbrook, of New York, have been awarded the contract for the draw bridge over the North Shrewsbury river, between Oceanic and Locust Point, at their bid of $34,063.

Manayunk, Pa.—The Court has appointed LEWIS ROVER, of Norristown, FRANK RAMSEY, of Plymouth, and HENRY J. SMITH, of Lansdale, to constitute a jury to act with a similar jury to view a site for a bridge over the Schuylkill river, at Manayunk, a short distance from the present toll bridge, which efforts are making to have declared a free bridge. The owners of the present bridge want $100,000 for their property, but neither Philadelphia nor Montgomery Co. is disposed to pay that amount when a new bridge can be erected for $35,000 to $40,000. The solicitors of the County Commissioners of the two counties therefore petitioned for the appointment of the jury with the object of erecting a new bridge, unless an equitable price is accepted for the present structure.

Uniontown, Pa.—The Pennsylvania Construction Co. is erecting the superstructure of the Fayette St. bridge.

Greensboro, Md.—The Berlin Iron Bridge Co., of East Berlin, Conn., is preparing estimates for the County Commissioners for an iron bridge over the Choptank river.

Montgomery, Ala.—The Alabama Midland Ry. Co. proposes to build a railway and highway bridge across the Alabama river if the city will give financial aid.

Mt. Vernon, O.—The County Commissioners will build an iron bridge across the Kokosing at Gambier St.

Zanesville, O.—The County Commissioners have located the new bridge at Monroe St; it will cross the railway tracks.

Terre Haute, Ind.—The County Commissioners will receive bids for two 45-ft. spans over the Wabash river, two 50-ft. spans over Otter creek, and one 50-ft. span over Prairie creek.

St. Joseph, Mich.—The Chicago & West Michigan Ry. Co. has been required by an order from the War Department to move its bridge from the mouth of the St. Joseph river to a point higher up the stream.

St. Cloud, Minn.—Proposals for a wood, combination, iron or suspension bridge across the Mississippi river at 10th St. will be opened by PETER BRICK, City Clerk, on June 10. Bids for substructure and superstructure together or separate. Particulars may be obtained of the City Engineer. Bonds for $80,000 have been voted for the work.

Rotheville, Mo.—The following proposals for a bridge over Yellow creek have been received by JOHN A. LEE, County Clerk, Keytesville, Mo.: Kansas City Bridge & Iron Co., Kansas City, Mo., $1,135; Variety Iron Works, Toledo, O., $1,150; Milwaukee Bridge & Iron Works, Milwaukee, Wis., $1,200; J. H. Mooney, Kansas City, Mo. $1,275; Geo. E. King Bridge Co., Des Moines, Ia., $1,286; Stuppe Bros., $1,297; St. Louis Bridge & Iron Co., St. Louis, Mo., $1,360; King Bridge & Mfg. Co., Cleveland, O., $1,515; Lane Bridge & Iron Co., Chicago, Ill., $1,525. The contract was awarded to the Kansas City Bridge & Iron Co.

New Birmingham, Tex.—The East Fork Toll Bridge Co. has been organized with a capital stock of $25,000.

Ogden, Utah.—It is proposed to build a bridge across the Weber river at the foot of 30th St.

Oakland, Cal.—It is proposed to remove the draw over the north arm of the bay at 12th St. and to build an iron bridge of 24-ft. span.

London, Ont.—Work is in progress on the foundations of the Thames river bridge for the Canadian Pacific Ry. at Pikeville. The contractors are Currie & Co. and Flook & Babcock.

The Lynchburg & Durham Ry. Co. has divided the contracts for 9 bridges between the Phœnix Bridge Co. of Philadelphia, Pa., and the Penn Bridge Co., of Beaver Falls, Pa.

The East & West Ry. Co., with office at Cross Plains, Ala., will want bids for several iron bridges.

Canals.—The New York State Legislature has passed bills appropriating $3,000 for repairs to the Erie canal and authorizing certain work to be done; appropriating $20,000 to provide ditches to carry off the leakage from the canals; appropriating $10,000 for rebuilding portions of the canal wall and culvert between the Oswego canal and the Oswego river at Oswego.

At Middlesborough, Ky., a contract has been awarded to Stephen Condon for building 2 miles of canal.

The Savannah & Ogeechee Canal Co., of Savannah, Ga., is improving its canal.

Work on the coffer-dam and the locks for the new canal at Sault Ste. Marie, Mich., has been delayed by labor troubles.

Viaduct.—*Denver, Col.*—The Denver Cable Ry. Co has awarded the contract for the large steel viaduct to the Wrought-Iron Bridge Co., of Canton, O., at $135,000. It will require 1,000 tons of steel work and about 1,000,000 ft. of B. M. lumber.

ELECTRICAL.

Electric Light.—*Putnam, Conn.*—The Putnam Light & Power Co. has been organized by the consolidation of the electric light and gas companies. President, FRANK W. PERRY; Superintendent and Secretary, ALLEN W. BOWEN.

West Troy, N. Y.—Only two bids were offered for lighting the village streets with electricity, that of the Thomson-Houston Co., of $5,000 for 50 lights of 2,000 c. p. each, being withdrawn. The bids received were from the Mutual Electric Light Co., of Brooklyn, N. Y., and

the Fort Wayne Electric Light Co. The former offered to furnish 52 lights of 2,000 c. p. each, to burn all night every night in the year, for $5,000, and to furnish additional lamps at $96 each. The latter company's bid was for 50 lights of 2,000 c. p. each for $5,000. The contract was awarded to the Mutual Co. This company controls the Knowles system. The contract is only for one year.

Mount Vernon, N. Y.—The village is to be lighted with electricity on the Thomson-Houston system at $100 per lamp per year for 31 lights.

Moorestown, N. J.—The Moorestown Electric Light Co. has been organized, and a committee has been appointed to investigate the different systems. President, J. H. LAMB; Secretary, J. S. ROGERS; Superintendent, RUFUS HILL.

Chattanooga, Tenn.—The Tennessee Electric Light Co. has been organized by GEO. B. PENNOCK, A. J. WINDOM, and A. M. JOHNSON. Capital stock, $100,000.

Opelika, Ala.—An electric light plant is proposed to be put in, and subscriptions have already been made.

Portsmouth, O.—The Gas Light Co. operates an electric light plant with 90 lights and proposes to lease it to the city for 3 years at $3,500 a year.

St. Louis, Mo.—Mr. Chas. Sutter, who has the contract for lighting the city with 2,200 arc lights of 2,000 c.p. each, has begun the erection of a 4,000 arc light plant with 6,000 H. P. steam plant. The incandescent lights (accumulator system) enable consumers to have light at all times, whether the machinery is running or not. The lights will be in operation by October.

Monte Vista, Col.—A local company, with $25,000 capital stock, has been organized to put in a plant with 500 Edison incandescent lights of 16 c. p. each.

Denver, Col.—The Denver Consolidated Electric Co. has been incorporated. President and Manager, C. H. SMITH; Vice-President, E. W. ROLLINS; Secretary, A. A. DENMAN.

Portland, Ore.—The Committee on Ways and Means has recommended that the proposition of the Willamette Falls Electric Co., to substitute arc lights for incandescent lights, be accepted for the reason that an increase of light is much needed in parts of the business portion of the city, and arc lights are the best and cheapest where strong lights are needed; and, under this proposition, such lights will be furnished to the city at a rate 17 per cent. less than the lowest rate ever proposed by any person or corporation.

Underground Wires in St. Paul, Minn.—The Council has granted franchises to the Edison and Thomson-Houston companies, but not to the Dorsett Co. The Edison Co.'s ordinance authorizes the company to go on and lay its wires underground under the provisions of the general ordinance for the future ordinances. In consideration of the privileges granted, the company must pay into the city treasury each year 3 per cent. of the gross receipts from the business done during the preceding year, for 2 years following the passage of the ordinance, and for the years thereafter such an annual amount as the Council may determine upon. It was also provided that unless within 12 months from the publication of the ordinance, the company has a plant of sufficient size to furnish 10,000 H. P. ready to go into full operation, then all powers and privileges granted shall terminate.

WATER AND MUNICIPAL.

Artesian Wells.—*Yorkshire, N. Y.*—A. G. PRESTON has struck water at a depth of 250 ft.

Georgetown, D. C.—A well is being bored, and will probably be 100 ft. deep.

Columbia, Ala.—An artesian well is being sunk, and pipes will be laid to distribute water through the town.

Sloss, Ala.—The North American Mining Co., of New York, has the contract for a well for the Sloss Iron & Steel Co.

Uniontown, Ala.—The public well is now down 740 ft, and is to be continued to 1,000 ft. or more.

Princeton, Ind.—The well is several hundred feet deep, but no water has been struck yet.

Jacksonville, Ill.—The Water Commissioners are having a well bored to test for a water supply.

Wapella, Ill.—Cantrell & Co. put down a well for JAMES BUTTERWORTH, and struck water at 105 ft.

Burlington, Wis.—A local company with a capital stock of $5,000 has been organized to have a well drilled. Proposals will be invited.

Utica, Minn.—The Chicago & Northwestern R. R. Co. has drilled a well for the stock yards; water is pumped by a wind engine.

Boone, Ia.—The well has been put down 1,882 ft; the last 48 ft. cost $75 per ft. A contractor has made a bid to continue the drilling to 2,000 ft. at $4.50 per ft.

Harrison, Neb.—A good supply of water has been struck by the new well.

Carson, Nev.—Geo. Hawkins is putting down a well which is to be 1,000 ft. deep.

Independence, Cal.—Work is progressing on the artesian well, and water is expected soon.

Galveston, Tex.—The Galveston Artesian Well Co. has been organized by J. W. BYRNES, W. H. SINCLAIR and others. Capital stock, $50,000.

Waco, Tex.—The Waco Artesian Well Co. has been incorporated at Austin with a capital stock of $250,000.

Sewerage.—*Westfield, Mass.*—The town meeting has appropriated $5,000 for sewers.

Cortland, N. Y.—A sewerage system is contemplated and a vote will probably be taken at the next election.

Orange, N. J.—The sewerage question is again being agitated, and a committee has been appointed to look into the matter.

Wheeling, W. Va.—A contract for sewer pipe has been awarded to McMahon, Porter & Co., of New Cumberland, W. Va.

Knoxville, Tenn.—The city proposes to apply to the Legislature for power to issue $200,000 bonds for sewers and $50,000 for public improvements.

Raleigh, N. C.—The city has voted to issue bonds for $75,000 for the construction of the sewerage system of which J. L. LUDLOW, of Winston, is the engineer.

Spartanburg, S. C.—A sewerage system is contemplated.

Natchez, Miss.—Work has been commenced on the sewerage system; it is being done by the water company.

Biloxi, Miss.—A sewerage system is needed. For particulars address the mayor or city clerk.

Circleville, O.—The Sewer Committee has awarded the contract for the trunk sewer to C. H. Connell & Co. at $35,312.98.

Armourdale, Kan.—The proposed sewerage system will probably be built soon; it will cost $270,000.

Helena, Mont.—Sewer contracts have been awarded to Burke & Fitzgerald at $11,995 and $24,795.

East Portland, Ore.—The sewerage question has been agitated several times, but no definite action has yet been taken.

Oakland, Cal.—The Board of Public Works intends to improve and extend the sewers.

Los Angeles, Cal.—It is proposed to issue bonds for sewers as follows: outfall sewer, $450,000; western intercepting sewer, $60,000; central intercepting sewer, $250,000; southern intercepting sewer, $60,000; 2nd St. storm sewer, $35,000; the hill storm sewer, $30,000; general sewer fund, $35,000. Total estimated cost, $1,100,000.

Corsicana, Tex.—It is reported that the mayor will shortly receive bids for the construction of the proposed sewerage system.

Windsor, Ont.—The Board of Public Works has awarded the contract for the McDougall St. sewer to contractor Bates, of Detroit.

Macon, Ga.—The Macon Gas & Water Co. has elected new officers as follows:—President, R. VAN STEENBERGH, General Manager of the American Gas & Water-Works Construction Co., of New York and Philadelphia; Directors, J. J. MACFARLAND, President American Life Insurance Co., of Philadelphia; LOUIS PFEIFFER, President Bank of America and Vice-President American Insurance Co.; GEORGE F. WORK, a Philadelphia capitalist. Capt. J. W. WILCOX is Superintendent and Engineer.

Peoria, Ill.—After considerable discussion the Council passed the water-works ordinance on May 4 by a vote of 10 to 6. Propositions had been received from 3 firms and that from Moffett, Hodgkins & Clark, of Watertown, N. Y., has been accepted. The city will pay $41,600 per annum for 1,000 hydrants. The franchise is for 30 years, at the end of which time the city may purchase the works or extend the franchise. For extensions of the pipe system there are to be 12 hydrants per mile and the city is to pay $75 per year for fire protection. Water is to be stored in 2 reservoirs of 15,000,000 galls. aggregate capacity.

Denver, Col.—The Denver Water-works Co. has now an aggregate capacity of 18,000,000 galls. per day, which will be ample for the next two years, but during that time the works will have to be enlarged to supply the increased population. The capacity is 12,000,000 galls. from the main works over West Denver and the business portion of East Denver; 3,000,000 galls. from the Platte St. station on Capitol Hill and 3,000,000 from the reservoir in the eastern part of the city. New pumps will be put in and the Platte river pumping station at 15th St. again used; a main has been laid from the reservoir in West Denver to these works. It is proposed to run the water-power plant for the South Denver water-works by water from the old Petersburg ditch.

Bloomington, Ill.—The Water Board, in its report for the year ending April 30, 1889, recommends that a second main be laid from the pumping station to the stand-pipe, that the pipe system be extended, and that a high-duty pumping engine of 3,000,000 galls. daily capacity be purchased. The tube wells have proved very satisfactory, and the water supply can be increased by putting down additional wells.

Bellingham Bay, Wash. Ty.—The Cornwall Co. is the prime mover in the construction of the Bellingham Bay water-works to supply the Bay cities from Lake Whatcom; the right of way is being cleared, and the works will be ready to turn on water by September. The water will leave the lake through a tunnel 10 ft. below high water, and flow through tunnel, cut, and flume 3 x 3 ft. to within 1 mile of the bay, where it will reach a reservoir large enough to hold 2 days' supply. From this point the water will be conducted down to the Bay in a 12-in. iron main, and the fall will give 235 ft. pressure at Sehome. The pipe line does not follow the creek, but runs south. The entire length of pipe line, flume and tunnel will be 4½ miles, and the total cost of constructing the works will be about $150,000. As the lake from which the water supply is obtained lies 317 ft. above the cities, a great pressure is obtained for domestic, manufacturing, and fire purposes.

Freehold, N. J.—The annual report of the Town Commissioners reviews the water supply question. In 1887, a Newark firm offered to put down a well, and to guarantee 125,000 galls. per day from an 8-in. well, but the matter was voted down. In January last, the Asbury Park Well & Construction Co. made a proposition to sink a 4-in. well at $1.50 per ft. and to guarantee a supply of 28,800 galls. per day. Prof. COOK, State Geologist, was applied to, and gave an opinion that a water supply would be found at a depth of 150 to 200 ft. The following is an estimate of cost made recently: 473 tons of pipe at $33, $14,153; special castings, $900; excavation and laying 30,675 ft. of pipe, $4,800; 50 double-nozzle hydrants, $1,500; valves, $850; 6 4-in. wells and connections, $1,800; pumping machinery, $2,250; engine house, $2,250; stand-pipe, $1,250; land for wells, etc., $2,000; total, $31,750. JAMES S. YARD is Commissioner.

Water-Works.—*Massachusetts.*—North Adams. The committee having charge of the addition to the water-works has engaged Prof. GREENE, of Troy, N. Y., as consulting engineer; Mr. A. W. LOCKE will have direct charge of the work.——Great Barrington. The fire district Committee on Water Supply is inspecting the various mountain streams within two miles of the village, to find an additional supply of drinking water, and obtain facts for a report, which will be submitted to the voters.——Amherst. The Amherst Water Co., at its recent annual meeting, elected W. A. DICKINSON, president, and E. D. BANGS, secretary.

Rhode Island.—Woonsocket. The Water Commissioners propose to put up an additional tank, with a capacity of 500,000 galls., at a cost of $10,000.

Connecticut.—Windsor Locks. The water company has now concluded its plans, and will soon start the laying of pipes. The contract will be let to the lowest bidder. The stand-pipe will be located on Birge's hill, a high elevation overlooking the town. It will be 100 ft. high and 20 ft. in diameter. The water will be pumped from the pond, 1 mile below the town, by water power, the company having bought the power and plant of the old English paper mill. Pipes will be laid in several streets. A force of 180 ft. can be obtained on Main St., which will afford ample fire protection. The supply is promised to be in working order within 70 days.

New York.—Addison. Contracts for the water-works have been awarded as follows: Pipe and specials, R. D. Wood & Co., of Philadelphia, Pa., $12,483.87; valves, valve boxes and hydrants, Ludlow Valve Mfg. Co., Troy, N. Y., $2,130.66; pipe laying, F. Leonard, $6,300; reservoir, F. Leonard, $6,500. CHAS. C. HOPKINS, of Rome, N. Y., is the engineer.——Westfield. Proposals for water-works, in accordance with plans and specifications, were opened May 11 by the Water Commissioners. There will be about 45,000 ft. of 4 to 14-in. iron pipe, and 16,000 ft. of 12-in. vitrified pipe; also hydrants, etc., filters and reservoirs.——Lansingburg. Work on the new intercepting reservoir has been resumed by contractors Sherman & McDonough under the engineer, Mr. W. S. FRANKLIN.——Amsterdam. The Water Commissioners have elected JAS. R. SNELL, president, and JOHN MCCLUMPHA, secretary. The necessity for an additional water supply is being discussed.

New Jersey.—Red Bank. It has been voted to issue bonds for $25,000 for increasing the water supply. Mr. JOHN H. COOK has been appointed Water Commissioner.——Long Branch. The Long Branch Water Co. shut off the water supply last week because the Commissioners had not paid the town's bill. This action caused considerable agitation and there was talk of organizing another company.

Delaware.—Wilmington. Surveys are being made for the projected water-works. The supply will probably be obtained from springs 3 miles north of the city.

Pennsylvania.—Reynoldton. The McKeesport Water Committee has agreed to furnish a water supply to the borough at 6 cts. per 1,000 galls. A pipe will be laid from the McKeesport reservoir across the river to Reynoldton.——North Wales. The North Wales Water Co. has earned a 5 per cent. dividend, but will reserve it for piping new streets.——Braddock. The suction pipes have been connected with the mains that extend across the river, and the water supply will now be drawn from the opposite shore.——Stroudsburg. The water question is still being agitated. H. S. PULERBAUGH, C. S. CHOONOVER and S. S. DIETRICK have been appointed a committee to receive propositions.——Annville. Water-works will be built by Raymond & Campbell.——Ridley Park. The Ridley Park Water Co. has elected R. S. PONEROY, president. About $17,000 worth of the stock has been subscribed for.

Virginia.—Roanoke. The distribution system is to be extended.

West Virginia.—Morgantown. The Union Improvement Co. will build water-works on the gravity system at a cost of $30,000. Mr. T. M. JACKSON is the engineer.

North Carolina.—Hendersonville. It is proposed to build water-works at a cost of $25,000. For particulars address F. WHITAKER.

Georgia.—Macon. A company composed of Baltimore and Philadelphia capitalists proposes to put in water-works, taking the supply from the McCall pond.

Florida.—Kissimmee. The Kissimmee Ice Co. wants bids on pipe, pump and stand-pipe for a city water supply. The city will take 40 hydrants. The population is 2,000.——Pensacola. The water company is to be required to prove by test that the capacity of the works is 4,000,000 galls. per day.

Alabama.—Spring Garden. It is proposed to pipe a water supply to the city from Glade spring.

Mississippi.—Natchez. The Natchez Water & Sewer Co. will build water-works. Bonds for $200,000 have been issued. Mr. J. A. JONES is at the head of the company.

Tennessee.—Johnson City. Proposals for constructing water-works will be received until May 23, by F. P. BAXTER, mayor, or J. A. C. LUSK, recorder.——Collierville. Water-works are projected.——Manchester. Pipe and a pumping engine are wanted by J. E. Thompson.

Ohio.—Upper Sandusky. The water committee has reported favorably on the ordinance granting a contract to James Langley & Co.——Marysville. Water-works are projected and C. F. LENTZ has been appointed by the City Council to look into the matter.

Indiana.—Covington. The vote on water-works was almost unanimously in favor of building the works.

Michigan.—Detroit. The Galvin Brass & Iron Works, of Detroit, have a contract to supply the city with gates, valves and corporation cocks for the year ending May 1, 1890.——Dowagiac. The contract for the water-works has been let to Keating & Sheehan, of Detroit, for $34,000.——Ypsilanti. The city has voted by a large majority in favor of building water-works.——Wyandotte. The city will build water-works this summer, and is asking for plans and specifications. For particulars address WM. CAMPBELL, mayor, or J. S. MCGLAUGHLIN, Jr., city clerk.

Illinois.—Springfield. An ordinance has been passed putting the works under the entire control of the city and relieving the present commissioners from their duties.——Jerseyville. About 4 miles of mains have been laid, connecting with the new artesian well.——Duquoin. J. B. Truesdale, of St. Louis, Mo., has made a proposition for the location of a water-works plant in the city. He would erect a stand-pipe or any system wanted, his bid being $2,500 a year. Mayor SOLOMON appointed Aldermen JENELLE, HOWELL and BRUCKSHAW as a committee to investigate the systems in use in Quincy, Jacksonville, Peoria, Bloomington, Litchfield and Cairo, a report of the investigation to be made to the Improvement Committee on May 24.

Wisconsin.—Washburn. The contract for putting in water-works has been awarded to Lewis & Maxey, of Gardiner, Me. Work will be commenced June 1.——Madison. A new storage reservoir is to be built, and proposals for the work have been received by Superintendent E. M. NICHOLS.

Nebraska.—North Platte. The North Platte Water-Works Co. will extend its pipe system 6,000 ft. this season.——Harrison. Proposals for the completion of the water-works will be advertised for. The water is taken from a well.——Wahoo. The official test of the new works was made May 3, and 4 streams were thrown to a height of 100 ft. for 2 hours. The works cost $60,000.

Texas.—San Angelo. The city has made a contract with J. L. MILLSPAUGH to furnish a supply of water for one year.

Colorado.—Brush. This town, in Morgan county, will be supplied with water by the Big Beaver Land & Canal Co., incorporated at Denver by WM. KNEARL, J. H. MCGINNIS, and EDWARD RITCHIE.

Oregon.—Portland. The Oregon Water & Street Ry. Co. has been incorporated by C. H. LARRABEE, C. H. PRESCOTT, and E. G. HUGHES to supply water to East Portland and Albina.

Utah.—Salt Lake City. The Water Commissioners propose to improve the City Creek to increase the daily supply to 4,000,000 or 5,000,000 galls.

Oklahoma Territory.—Guthrie. A water-works company has been organized and a large tank has been erected for temporary use.

Canada.—Toronto, Ont. The Water-Works Committee will open bids June 3 for 10,400 ft. of 48-in. flexible joint cast-iron pipe or 10,400 ft. of 48-in. steel plate pipe with cast-iron flexible joints, or 4,500 ft. of 48-in. flexible joint cast-iron pipe and 6,000 ft. of 60-in. steel-plate pipe with cast-iron flexible joints; 8 double screw valves; 1,500 ft. of 36-in., 48,000 ft. of 12-in., and 46,000 ft. of 6-in. cast-iron spigot and faucet pipe; and 90 valves. Also 2 pumping engines of 2,500,000 or 3,000,000 galls. daily capacity, with boilers, etc., complete.

Special Reports of Water-Works Construction.

Springvale, Me.—Regarding the new water supply for this place, E. F. DAVENPORT sends us the following:

The Butler Springs Water Co. has recently been incorporated to furnish a pure water supply. Permission to dig up the streets has been granted by the selectmen and three miles of 4 and 6-in. mains will be laid as soon as possible. President IRVING A. BUTLER. Secretary and Treasurer, F. A. CLARK. Superintendent, E. F. DAVENPORT.

Keene, N. H.—The following is from P. T. BABBIDGE, Superintendent of the water-works:

It is proposed to change a portion of the mains each year from cement lined to cast-iron pipe. About $10,000 will be expended for this work this season.

Milton, Mass.—E. D. WADSWORTH, President of the Water Co. sends us the following:

The Milton Water Co. has been organized. The population to be supplied is too small to warrant the construction of a reservoir and establishing a pumping plant, and the topography of the country will not give sufficient head for a gravity system. An unsuccessful attempt was made to secure a supply from Boston. Negotiations are now pending for a supply from the Hyde Park Water Co. Treasurer, SAMUEL GANNETT. Population to be supplied, 1,500; of town, 4,000.

Bristol, Conn.—Secretary of Water Co., C. S. TREADWAY sends us the following:

A storage reservoir to cover 19 acres and have a capacity of 95,000,000 galls. is in process of construction.

Newburg, N. Y.—Superintendent of water-works, W. C. MILLER, sends us the following:

The question of filtering the city's entire water supply is being considered, and an additional pump for high service will probably be put in.

Lockport, N. Y.—The following statement of extensions and additions to be made this season was given by R. J. STENETT, Superintendent of the water-works:

To advertise for a new 5,000,000-gall. pump, to be complete within one year and paid for on the rental system, and lay 3,800 ft. of 6 in. pipe. Petitions for other extensions are now before the council.

Susquehanna, Pa.—C. A. MILLER, formerly Superintendent and Secretary of the water company, sends us the following:

One mile of pipe is being laid and an additional reservoir built. Cost of improvements, $8,000. Secretary and Treasurer, C. F. CURTIS.

Gainesville, Fla.—Concerning the projected water-works at this place, B. C. DRAKE sends us the following:

An attempt to establish works will be made this summer. Address the mayor or B. C. DRAKE.

Tallahassee, Fla.—The following is from G. SAXON, Secretary of the water company:

Work on a pump to stand-pipe system will be begun by the Tallahassee Water Works Co., Aug. 1, 1889, and completed Jan. 1, 1890. The supply will be taken from a spring or wells. The city has guaranteed $2,400 per annum for 60 hydrants. About 6 miles of mains will be laid. Capital stock, $50,000. Bonds for $40,000 will be issued. President, R. L. BENNETT. Population, 3,500.

Nicholasville, Ky.—J. S. BRONAUGH sends us the following:

One of the hindrances in securing works is to find a supply of water. The subject is being actively discussed.

Covington, Ind.—J. C. NELSON, Clerk, sends us the following:

The vote to establish works was carried by a large majority. Nothing further has been done.

New Castle, Ind.—Regarding the water-works for this place we have received the following:

Bonds will be issued and works built by the city. Estimated cost, $20,000 to $30,000. Water will be pumped from a flowing well to a tank or stand-pipe. Chairman of the Water Board, S. H. ELLIOTT. Engineer, J. D. COOK, Toledo, O. Contractors, Holly Mfg. Co., Addyston Pipe & Steel Co. and J. W. MAXWELL. Work will be completed in August.

St. Johns, Mich.—The following is from C. P. BAKER:

Bonds for $45,000 will be issued by the village. It has not been decided whether works will be built by a company or the town. It will be a direct pressure system. Village President, J. D. HENDERSON. Chairman of the Water Board, H. W. MORRIS. Engineer, H. FIELDEN.

Cherokee, Ia.—Chairman of the Water Board, J. C. HALL, sends us the following:

Water for fire and domestic use will be pumped from the river and wells to a stand-pipe. Estimated cost, $25,000. Contracts have not been made. Work will be commenced June 1, and completed August 15. Engineer, W. W. CURTIS, St. Paul, Minn. Population, 3,500.

Baxter Springs, Kan.—The following is from H. R. CROWELL:

A party is wanted to take the contract and build works. A dam has been constructed, the power is available, and buildings for the machinery have been erected.

Lonoke, Ark.—D. DANIEL, Chairman of the Water Committee, sends us the following:

A driven well has been sunk and an ample supply of water obtained. A small engine and a 30,000-gall. tank will be purchased. Address, Committee on Water-Works. Population, 2,000.

Lockhart, Texas.—The following is from JAS. G. BLANK:

Alterations to cost $3,000 will be completed by June 1. A 20,000-gall. steam pump is to replace the windmill which now raises water to a tank of 10,000 galls. capacity.

Ketchum, Idaho.—GEO. M. SNOW sends us the following:

The Ketchum Spring Water Supply Co. has awarded the contract for a complete gravity system to the Puget Sound Pipe Co. Work is to be completed June 1, 1889. The supply will be taken from three springs, and a reservoir built. Estimated cost, $12,000. President, GEO. STEWARD, Secretary, GEO. M. SNOW. Population, 1,000.

Picton, Ont.—The following is from WM. J. PORTE:

A contract was let to—DE LEVELLER, of Montreal, in February. Works are to be completed in September, 1889. Work has not yet been begun. Mayor, W. T. CRANDALL.

Extensions and Additions to Water-Works Systems Contemplated for 1889.

(See The Manual of American Water-Works for Addresses.)

(Continued from page 418.)

City or Town.	Pipe.	Hydrants.	Valves.	Meter
New York.				
Richfield Springs	*1,000 ft. 6-in.			
Pennsylvania.				
Harrisburg	8,000 ft. 6-in	25	34	75
Humm'lst'wn	1,000 ft. 6 and 4-in.	3	1	
Meyersdale	1,000 ft. 3-in	1	1	
Pittsburg	110,880 ft. 30 to 4-in	175	250	
Shamokin	9,000 ft. 6 to 3-in.	4	12	
West Chester	1,500 ft. 6-in.	5 or 6	Unk'n	
Virginia.				
Lexington	7,920 ft. 3-in	8 or 10		
W. Virginia.				
Wheeling	4,000 ft. 20 to 10-in	10	15	
No. Carolina.				
Salem	1,160 ft. 4-in	4	2	
So Carolina.				
Orangeburg	+28,000 ft. 6 and 4-in.	94	15	
Georgia.				
Bainbridge		10		
Brunswick	15,840 ft. 6 and 4-in	Materials purchased		
Florida.				
Fernandina	29,040 ft. 10 to 4-in	53	21	
Lake City	‡5,000 ft. 2½-in.			
Pensacola				12 or 15
Alabama.				
Bessemer	7,920 ft.	Unknown		
Birmingham	79,200 ft. 30 to 6-in	140	100	100
Florence	¶ 9,180 ft. 6 and 4-in	20	25	Unk'n
Selma	7,253 ft. 6 and 4-in.	2	2	
Talladega	10,560 ft. 6-in.	24	6	3
Tennessee.				
Bristol				10
Nashville	‡21,120 ft. 36 to 6-in	40	20	Unk'n
Kentucky.				
Belleview	10,000 ft. 6 and 4-in	25	20	
Covington	**6,400 ft. 6-in	14		
Maysville				30
Iowa.				
Clarinda				5
Clinton	31,680 ft. 10 to 6-in.	70	26	
Council Bluff	12,000 ft. 8 to 4-in.	30		
Dubuque	7,920 ft 6-in	10	15	
Ida Grove	++ 600 ft. 1¼-in			
Independence	7,920 ft. 6-in	1	1	25
W. Burlington	3,000 ft. 6-in.	6		
Minnesota.				
Mankato	‡‡ 6,000 ft. 6-in	B'g't 20	10	25 or 30
St. Paul	171,600 ft. 20 to 4-in	300	225	50
Winona	23,000 ft. 8 and 6-in	50	24	
Kansas.				
Cherry Vale	7,100 ft. 6 and 4-in.	12		
Hutchinson	§§ 35,000 ft.	80	15	15
Junction City	¶¶ 7,080 ft. 10 to 4-in	6	6	4
Marion	1,000 ft. 5 and 6-in.	5	4	
Paola	2,200 ft. 6 and 4-in.	4	4	
Winfield	*** 1,400 ft. 16-in.			
Dakota.				
Aberdeen	11,920 ft. 6 and 4-in	15	9	
Deadwood	+++ 1,000 ft.		2	
Huron	5,280 ft. 6-in.	8	10 or 12	
Pierre	10,560 ft. 10 and 8-in	24	10	On all serv's
Wyoming.				
Green River	5,000 ft. 6 and 4-in.	5	10	50
Missouri.				
Fulton	‡‡‡ 4,065 ft. 8 and 6-in.	11	6	
Independence	15,840 ft.	Unk'n		
Lexington	¶¶¶ 4,000 ft. 3-in.			
Marysville	2,640 ft. 6-in.	3		
St. Louis	§§§ 32,800 ft. 6-in.	132	53	Unk'n
Arkansas.				
Camden	‡ 10,560 ft. 6-in.	"Don't know yet."		
Fort Smith	52,800 ft. 10 to 6-in.	100	12 or 15	8 or 10
Texas.				
E. Dallas	10,560 ft. 6 and 4-in.	20	6	
Kyle	*	30		
Lampasas				2
San Angelo	³ 10,560 ft. 8 and 6-in.	35	25	20
Colorado.				
Colorado Springs	52,800 ft. 16 to 3-in.	15	10 or 15	
New Mexico.				
Springer	7,560 ft. 8 and 6-in.	10		
Washington.				
Seattle	⁴ 105,600 ft. 20 to 2-in.	Unk'n	100	100

*Two 2,000,000 gall. Hyatt filters to be placed.

+To add 20 ft. to height of stand-pipe. Will also put in a new pump.

‡To erect new tank or stand-pipe.

¶Will probably double capacity of works this season.

§To purchase a 15,000,000-gall. engine in about three months.

**Will extend system to supply United States barracks near by.

++To drive 12-2-in. wells.

‡‡Will put in a new pump and erect new pumping station.

¶¶Several wells will be sunk and new buildings erected.

§§Four new boilers to be added and buildings will be greatly enlarged.

***A 1,250,000-gall. Oliphant filter will be placed, inlet crib built and 1,400 ft. of suction pipe laid.

+++One mile flume will be built.

‡‡‡To erect a new stand-pipe, 114 ft. in diameter by 60 ft. high.

¶¶¶Additional 2,000,000 gall. setting basin to be built.

§§§Low service being extended.

¹"We propose putting up a new stand-pipe, 15 ft. in diameter by 100 ft. high."

²"Another pump to come with it. R."

³Expect to place an additional engine, boiler and tank.

⁴A 5,000,000-gall. pump and boilers will be added.